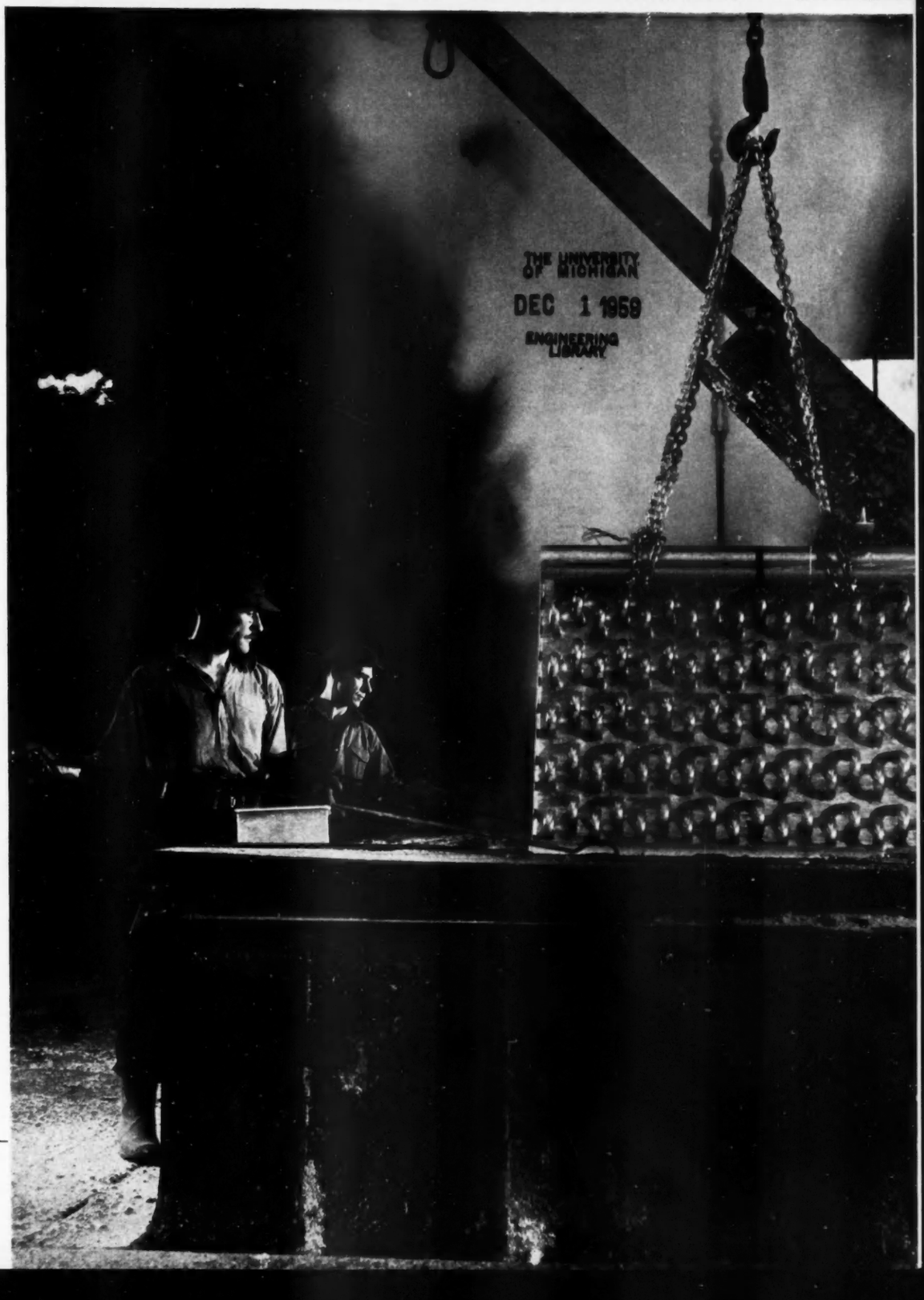
ENGINEERING



THE UNIVERSITY OF MICHIGAN
DEC 1 1959
ENGINEERING LIBRARY

R YEARS OF
AGEMENT SELECTION
. E. Roff

S FOR
NTER RUNNING

THRUST REVERSAL
REDUCED NOISE

E PREVENTION
BETTER THAN CURE

LING TRIALS IN
WAKE OF A TYPHOON
Commander Peter du Cane

E
/-

Dip Galvanising

XUM

There is no substitute for a C.A.V. Paper Filter

Where else can you find a filter of such high efficiency with adequate service life? The C.A.V. fuel oil filter removes from the fuel a high proportion of the minute abrasive particles which wear the finely fitting parts of fuel injection pumps and injectors, and which pass through many filters. But with high efficiency it is inevitable that the filter element will become choked in time—its life depends largely on the effective filtering surface area. In the C.A.V. filter this is 560 sq. inches—several times more than most other types, ensuring the longest life commensurate with adequate filtration.

Great care is taken in testing and checking C.A.V. paper filter elements during manufacture. Substitutes are frequently faulty and are no safeguard to fuel injection equipment.

WHY TAKE RISKS? The C.A.V. element is low in price—insist on the genuine article.

C.A.V.

The World's Largest Manufacturers of

FUEL INJECTION EQUIPMENT

C.A.V. LIMITED · ACTON · LONDON W.3

ENGINEERING
PUBLISHED EVERY FRIDAY
Vol. 188 No. 4881 6 November 1959

Contents

429 **Leading Article**
Is Three Years Enough?

430 **Plain Words**

430 **Weekly Survey**

431 **Letters to the Editor**
Thermoelectric Power

Special Articles
435 Four Years of Management Selection
440 Rolling Trials in the Wake of a Typhoon

436 **Meetings and Papers**

438 **Atomic Review**
Kiloton Ploughshares

444 **Automobile Engineering**
Cars for Winter Running

445 **Companies in the News**

449 **On the Shelf**

449 **Publications**
The Individual and the Universe
Ten Miles High Two Miles Deep
To Feed the Hungry

450 **New Books**

460 **At Home**
Safe Home

. . . . . .

432 **New Plant and Equipment**
Grinding wheel dresser, Self-propelled well-point drill, Cam timer, Temperature controller, Oil fired air heater, Paint sprayer, Accelerator, Balancing machine, Welder, Pleat wrapper, Hand torch, Heat treatment unit, Induction coupling, Bolometer, Gas regulator, Vernier protractors, Water treatment plant

437 **The Human Element**

442 **Construction**
Low Cost Oil Jetty for Supertankers
Into the Car Age
Weekly Construction News

446 **Research and Development**
Ministry Laboratory Directs Inspection
Image Intensifier with High Definition
Matching Positive Displacement Superchargers to Four Stroke Diesels
Measuring Low Activity
Burnup and Flux Instrumentation

451 **Metals and Materials**
Elastomers Improve Sealing and Glazing
Why Lubricate Contacts
Silicone Backing Strips

453 **Design**
Jet Thrust Reversal and Reduced Noise
Solenoid Operated Lever Valve
Hydraulic Gearbox for Machine Tool Control
Design Picture Page
Diesel Electric Locomotive for the Argentine
Roller Bearing with One Piece Cage

457 **Operation and Maintenance**
Fire Prevention is Better than Cure

458 **Production**
Ford Expansion: Another Phase Completed

459 **Marketing**

ENGINEERING *Appointments Section faces page 444*

Is Three Years Enough?

As if it were not enough that already two separate quarts are contending to get into the pint pot of the three year university course for a scientific or engineering degree, a third measure is now being urged by those who rightly see the future importance of engineers and scientists in the highest administration of this country.

Well known by now is the dogged, nose-to-grindstone student on a state scholarship who pours the whole of his energy and attention for three years into, first, the basic disciplines of his chosen field along lines where the standards required are constantly rising, and second, into mastering some of the changes and developments in application that come up almost as fast as the student studies. Faster change, higher standards, more complex techniques, all these are certainly coming to the student in the second half of this century and, in this country at least, while the number of university places will rise, it appears almost certain that the competition to fill them will rise with it. This must make for a sterner view by university authorities of performance in the freshman year, and that in its turn to a more grim and earnest application by those who should in theory be absorbing the broadening, cultural airs of the students' union and the student's private rooms.

But now there is the swelling chorus, most recently and tellingly rephrased by Lord Weeks, acclaiming the future high role, in government, in industrial leadership, and in university administration, that those grounded in the physical sciences must play if we are to improve, even retain, our standards, whether material or intangible. While the scientific disciplines need not be behind those of the humanities in shaping the mind to deal with matters of state they plainly do not include the background of history and philosophy integral to the old form of a university and essential to proper government. If high level responsibility is lying in wait for more and more engineers, it may be that specially devised courses, embracing social history, economics, even perhaps languages, are needed before launching the "complete engineer" on his career.

It is worth recalling here what Sir Patrick Linstead, rector of the Imperial College of Science and Technology, said as long ago as 1955—and the pressure on students has not stood still since then—that it was not possible to introduce non-scientific subjects into the formal curriculum while the total length of the degree course remained the same. Two years nearer the present, a widely supported European conference in engineering education included in its definition of the professional engineer this last paragraph:—

> By virtue of his education and training he will have acquired a broad and general appreciation of the engineering sciences as well as a thorough insight into the special features of his own branch, with the result that in due time he can give authoritative technical advice, or be responsible for the direction of important tasks in his branch.

This is a far cry from the movement towards engineers in top positions of decision. Inevitable as the direction of the move may be, it must just as certainly react on the training of those who are to be carried along with it. The number of men in post-graduate study rises, although it has wisely been said that it is a good thing for a graduate to get to grips rapidly with his chosen industry. There would be no widespread support for a further post-graduate period spent in developing the ability to manage men and direct policy. Nor would the grammar schools, battling away in fierce competition, listen willingly to the proposition that they should add, to any worthwhile extent, to the burden on their hard pressed sixth formers.

Yet it is one of the commonplaces that our future is as bound up with the standards of our graduates as with any other single issue. The factors capable of alteration to meet the problem are not many. The standards of teaching are not in dispute, though the use of the best practising scientists and engineers from industry and Government research would be a useful improvement. The amount of work that is got out of the students is probably too high now. What has to be learnt will increase and multiply; any cutting down on the early stages of classical science will find very little time to save. The university-favoured idea of a sabbatical year, in which the engineer would be released every seventh year to return to college and catch up on developments in his own and related fields, would help the undergraduates—if they have time—to share the industrial experience of the "sabbaticals."

Altogether more movable is the length of the course. A three-year course is short enough for the end to be in sight and not long enough to be much more than a prolonged cramming session. A four-year course might put the finals far enough from the end of the student's nose to give him that pause in which to gather from a university life the knowledge of men, and the self-knowledge, which if he is to be required to assume the heavy burden promised him for the future will be as necessary as all his technical foundations.

Cover Picture.—*Hot dip galvanising a bank of brine-circulating coils for a refrigerated ship.*
(*Nurnberg photograph for* ENGINEERING)

Plain Words

On the shop floor, productivity measurement has become a precise if questionable science. The office, on the other hand, would baffle even Frederick Winslow Taylor. No one can measure the useful output of an office, and lacking any yardstick of achievement, we strive to make our efforts more conspicuous. I wonder how much energy we waste.

It may be roughly estimated that of a working day's energy expenditure, 9 per cent goes in trying to look busy, 6 per cent in recovering from telephone calls, 12 per cent in trying to be one up on all the others, 8 per cent in straining to hear what's going on in the next office (in the open-plan system random encounter and peering account for a similar percentage), and 10 per cent in talking to people who aren't really listening.

People may be regarded as combined transmitters and receivers, differing in power and receptivity. But no matter how strong the transmitter and how sensitive the receiver, there will be no communication unless the wavelengths coincide. A man's success in persuading others is seldom in proportion to the energy he expends. Take the extreme case of reciprocal opacity. Any mother who suggests a course of action to her daughter-in-law is likely to encounter a negative reaction. Thus considerable energy may be dissipated without visible result.

The acceptance of an idea depends too frequently on its source. Some people have low persuasion ratings but pretty good ideas. It is equally frustrating to have occasional brilliant ideas, which, being exceptions in a long line of platitudes, pass unappreciated.

The predispostion to receive an idea is termed by those who understand such matters "psychological set." If it is the sort of idea you might have had yourself you are likely to accept it. (Don't just read any paper, read the one the boss reads.) Similarly if it is the sort of idea you expect from the man who submits it, you will be quicker to recognise his meaning. Unfortunately, through impatience, we are too ready to classify our colleagues: bohemians, rakes, plodders, practical men, layabouts; and if their proposals do not fit these preconceptions, we fail to understand their arguments.

Others find that their proposals, though meeting immediate resistance, are later reproduced by the persuadee—a kind of hidden or subliminal persuasion.

Finally there is the super-persuader. He is like Bottom, who irrespective of his own accomplishment, bewitches by some quality which he supposedly embodies. Today the scientist often wears this magic aura. A modest even mediocre talent, given the right label, may convince the world. His words, though trite, are heard with admiration. In the same way, by growing a beard you may amplify a moderate distinction.

Well, there goes the other 55 per cent!

CAPRICORN

Weekly Survey

Strengthening the Weak Spots

For all the world to see the Government has dramatically drawn attention to Britain's strong financial position by repaying in full, five years ahead of time, the $250 million (£90 million) loan obtained from the Export-Import Bank two years ago.

Mr. Samuel Waugh, president and chairman of the bank, comments: "We find Her Majesty's Government, as a result of sound fiscal policies, in a solid financial position . . ."

At home the Government has announced the terms of the Local Unemployment Bill by which it hopes to tackle those areas of higher than average unemployment where the nation's prosperity is known of but not shared in. The new bill establishes three new management corporations, replacing the existing five estate companies for the development areas. With the increase in area into which each new body must try to encourage development, there comes the risk of greater remoteness from the problems at ground level. In another context Lord Chandos was last week warning the members of the Royal Commonwealth Society against overall development corporations being set up in the underdeveloped territories. Thousands of successful mining, chemical and agricultural companies could be thought of, said Lord Chandos, but he could think of no example of a successful exploitation company over a wide field.

The new management corporations are not exploitation companies, but there are obvious parallels. If the forward developments of industry had not already avoided the areas which will be the concern of the new corporations they would not exist. To do their job at all they need two weapons.

The first is the will to achieve a new deal for our own backward areas. The Labour Party maintained in the election exchanges that enough powers were to the Government's hand to do something for Scotland, Northern Ireland and the other black spots. What was lacking, it was alleged, was the will. Now there is the new machinery, and certainly all the sounds of a new determination. There is also a grey future hanging over some coal mining areas of a situation that, if it is not made to improve, will become noticeably worse.

The second weapon necessary to the corporations is incentive. Exhortation is not going to get unwilling industrialists into action. One of the known factors in this case was that factories built in these difficult areas were worth less once completed than they cost to build. The Government grant of 85 per cent of the difference between the capital cost and the post-erection value will now overcome this problem, and it is no longer a condition of the grant to be able to show that other capital sources have been tried without avail.

How to Run a Railway

With the setting up of the United Kingdom Railway Advisory Service (UKRAS) an impressive list of matter on which railway administrations in the area of the Economic Commission for Asia and the Far East can be advised has been drawn up. The list covers research, safety, electronics, automation, motive power, maintenance, signalling permanent way, accounting, statistical procedure, rolling stock and power supplies and "any other matters."

An immense amount of work is being done by British Railways to create a modern service. It has been rightly said that in the north-Kent works the Southern were building a new railway while keeping the old one running; which must give our railway engineers a great deal of experience with which to assist overseas nations at an earlier stage of development.

UKRAS will operate as a clearing house, receiving requests from abroad and passing them on to the expert in this country for his recommendations. It is not intended to make any charge for this consulting service, but where a small charge is needed to cover unavoidable expense then the railway that put in the enquiry will be told before the request is pursued.

Such an extension of British know-how will be encouraging to the locomotive builders. It is worth reflecting that if we leave this sort of job undone sooner or later the Russians will come and do it instead.

Complacency in Shipbuilding

With the British shipbuilding industry poised at the edge of what may be a serious recession, a productivity team has recently returned from Sweden where it has inspected the Goteborg shipbuilding yards. The standard of efficiency in these yards, their ability to maintain a good order book and freedom from labour troubles are widely known. The productivity team has come to the conclusion that our industry has little to learn from Sweden in the way of technical improvement.

It was not expected that the team would find anything unusual in engineering knowledge and practice in Sweden. It is also true that the British industry is seriously handicapped in putting into practice some of the modern ideas of layout, owing to congestion on the banks of shipbuilding rivers and estuaries; but the reputation of the Swedish yards in design, prefabrication, a general willingness to try out new ideas and, above all, the good record of management-labour relations, strongly suggests that the Swedes are well ahead of this country on the management side.

In this country there is a tradition of militancy and suspicion on the demarkation of skilled jobs which would do justice to a litigacious primitive community in the African bush. To some extent this is a problem of personalities but there is little doubt that there is need in British shipbuilding for an imaginative and bold policy by managements to try to break the vicious circle of demarkation disputes, low productivity and high prices. What is wanted, also, especially on the side of labour, is a willingness to find a constructive solution, even at the expense of a modest sacrifice or a temporary loss of face.

Common Market Concentration

One of the main arguments in favour of the establishment of the European Common Market and the Free Trade Area is beginning to come true. The European Common Market is beginning to bring about a concentration of industry into larger and (it is hoped) more competitive groups.

The latest example of this is the French machine tool industry where small firms have been encouraged to re-group for export purposes. The French have gone so far as to give fiscal aid to further this development and it does not look as if the mild protests from certain other countries within the European Economic Community will have much effect, since the concentration of industry into larger and more efficient units is the declared intention of the Treaty of Rome which set up the Community. The French, however, have gone one stage further and have offered special amortisation concessions to

machine tools made in France and ordered by French manufacturers. Such manoeuvring is inevitable. The treaty would not have been signed if a mass of detailed provisions had been written into it. As it is, the slow procedure for examining the new situation created by the French may be overtaken by the lapsing of the law in France which makes it possible, and the French may choose not to press the matter further.

While the Common Market continues to develop along prescribed lines, the prospects for a marriage of convenience between the European Common Market and the Free Trade Association get no better. Professor Halstein, head of the Common Market Commission, has pointed out that the European Common Market is moving towards non-discrimination in trade and in accordance with the principles of GATT, a line of development which OEEC could hardly be expected to pursue. This is probably a broad hint that there is no hope of using OEEC as a bridge between the two trade areas. Professor Halstein has indeed suggested that the European Economic Community should make trade agreements with individual countries which is an obvious hint that the European Economic Community thinks it can get by very well on its own terms with the rest of Western Europe.

Literary Dam

Not for the first time a Russian scientist has put forward the proposal that the Bering Straits should be closed by a dam. In this case, outlined by Stalin prize winner, Peter Borisov, a 46 mile dam would be built across the Straits in a combined United States-Russian enterprise.

The first purpose of this dam would be that of so altering the extreme northern climate that the conditions of many countries within climatic reach of the north pole would be much milder in the winter. At the same time the north Polar ocean would become navigable.

With a Russian space station photographing the other, and apparently less photogenic, side of the moon it is not too easy to doubt Borisov's suggestion that the climatic changes be brought about by pumping vast quantities of water over the dam, from the Arctic side to the Pacific.

If this achieved its object and drew Gulf Stream waters up towards the Arctic ice there could well be a rise in the sea levels of the shores of this country. What that would mean cannot be said with any certainty and it cannot be assumed that the weather effects would be an unmixed blessing.

Second to doubts about the advantages is the dubious proposition that Russia, America, and a string of others might cooperate in the venture and find the £6,000 million it would cost. This is a far stretch from the sort of money obtained with so much difficulty to keep the United Nations Organisation and its special agencies going, where it is more or less agreed that some benefit emerges. Raising the cost from countries of both blocs is likely to be no easier to achieve than, for instance, agreeing a date for a summit meeting.

Perhaps before deciding to move home and factory higher up the mountain it is worth looking at the publication in which Borisov's scheme appeared. It is the Soviet journal *Literary Gazette*.

Warning to Mariners

If the Canadian weather does not break up, the St. Lawrence Seaway will stay open until 30 November, the Sault Ste Marie Canal will stay open until 12 December and the Welland Canal until 15 December.

The Welland canal in particular has such a heavy winter programme of dock wall construction and other work that, in the curious canal operators' phrase " unwatering " will be carried out immediately after 15 December. This means that ship masters must so arrange their schedules as to be on the seaward side of the canals by the dates given or they will find their ships passing the winter months land locked and no doubt snow covered.

The steady rise in the cargoes carried has shown the first evidence of the ability of the seaway to increase even more the prosperity of the north American hinterland. The trade has not been without its problems, both of rates and of special equipment. On the financial side, special problems related to marine insurance are under the expert eye of an ad hoc committee set up by the International Union of Marine Insurance. The committee has representatives from Canada, the United States, the Scandinavian and other European countries, as well as from the United Kingdom.

The Battle for the Brains

Demand for management staff in sales and production increased during the third quarter of this year and that in research and development tended to fall away.

This is one of the most significant of the conclusions drawn by Management Selection Limited, the first formed and the largest of the firms specialising in the field of selecting men, and women, for the above £1,000 a year jobs (mostly well above). They have now launched the *MSL Index of Executive Employment*, which is to be issued quarterly, analysing trends in the demand for management people and also the manner in which the demand is met.

In six national papers carrying a large amount of job advertising aimed at managers, MSL counted up 50,000 advertisements in the 12 months up to September this year, covering 18,974 jobs. Six thousand of these were in research and development, the field in which the quickest reaction to change, due to defence contracts and so on, may be looked for, and 4,000 in production.

Mr. H. E. Roff, managing director of Management Selection Limited (who writes on this subject on page 435 of this issue) commented that the figures showed a massive attack being mounted by firms trying to attract the best of the technically qualified.

The index is to be circulated not only to MSL clients, but to a small limited circulation of those most directly concerned, and to the Press. It presents a fresh, and not before easily available, measuring stick in human terms of industry's present activity and confidence in the future.

Of selection by the outside specialised consultancy it must be asked whether its wide use will not put in place, over a growing number of posts, the type of man who satisfies the image of a good manager—an image that may grow up within these agencies.

This could be the safe, reliable man, of no mistakes and no vision, qualified to please the interviewers but unqualified to win battles in a tough, competitive world.

Bonfire Note

Every year we make our *feu de joie* to Guy Fawkes, and then dismiss fireworks and bonfires from our minds for another 12 months. That is as it should be. We have more serious things to think about.

More than 10,000 fires occur every year in factories alone. Putting aside human considerations, we simply cannot afford it. Disruption of production, the consequent failure to meet order commitments, and the economic upheaval generally which a fire causes are an unnecessary burden on a nation which depends upon trade and commerce for its very existence. Effective fire precautions are, on the whole neither difficult nor costly. In any case, whatever they cost, in time or money, might well be infinitesimal compared with the cost of a fire. It is really a matter of simple economics.

Letters to the Editor

THERMOELECTRIC POWER

SIR, Your recent series of articles (particularly that in ENGNG., 11 Sept. '59, p. 161) assessing the potentialities of thermoelectric power was very interesting, and we agree that serious consideration should be given to this method.

We feel, however, that the authors have been a little optimistic in some of their assumptions, and we do not share their confidence that " further improvements in materials and methods of construction can be expected to lead to a performance equivalent in thermal efficiency to modern methods of generation."

Curves of cost and efficiency were given in

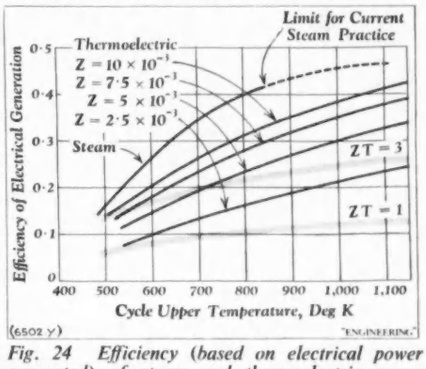


Fig. 24 Efficiency (based on electrical power generated) of steam and thermoelectric power stations, as a function of maximum temperature (reactor coolant outlet) at $T_0 = 300°$ K for thermoelectric generators.

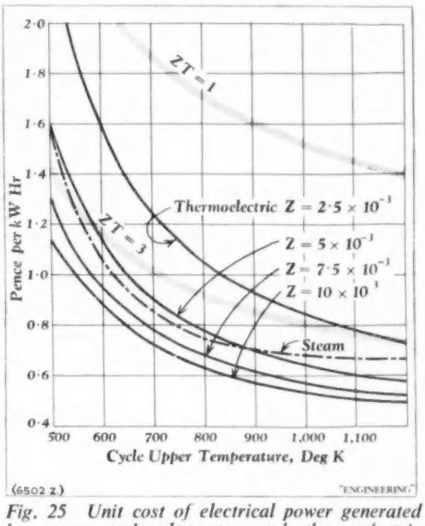


Fig. 25 Unit cost of electrical power generated by steam turbo-alternator and thermoelectric stations as a function of cycle upper temperature. Thermoelectric generator cost £20 per kWe. Load factor 80 per cent.

In the above diagrams, reproduced from p. 161, our correspondents' curves for ZT = 1 and ZT = 3 have been added as shaded lines.

Figs. 24 and 25 for various values of the thermoelectric figure of merit, Z, over a wide range of temperatures. Unfortunately, although quite high values of Z can be achieved at low temperatures (and, indeed, thermoelectric *refrigeration* is on the verge of commercial exploitation), Z drops steadily as the temperature T rises, and the achievable value of the product ZT is approximately constant.

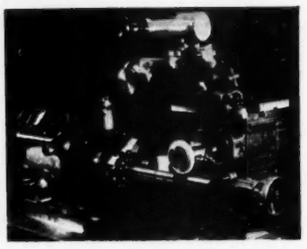
The best materials known at present (bismuth telluride is one) have ZT around 1·0 and, when the curves corresponding to this value are plotted on the graphs given in the article, as shown in the accompanying illustrations, it can be seen that the position at present is hopeless as regards both efficiency and cost.

Furthermore, there are good reasons on the

Continued at foot of next page

GRINDING WHEEL DRESSER

No Templates Needed



FOR form dressing grinding wheels, the Optidress does not require the use of a template.

The attachment has been designed as a permanent fixture for the grinding machine and allows one radial and two straight line motions to be carried out in one setting. In addition, the wheel form can be checked after dressing.

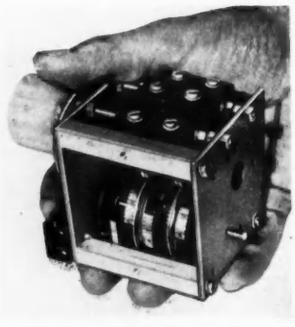
A built-in microscope facilitates the centring and positioning of the diamond and enables both the wheel and diamond to be kept under constant observation while blending a radius into a tangential run-off. A graticule incorporated in the eyepiece carries radius markings from 0·025 in to 0·375 in in increments of 0·01 in. The arm carrying the diamond has a movement of $\frac{3}{4}$ in allowing for a $\frac{3}{4}$ in radius.

The slide for dressing straight lines has a total movement of 1 in, the traverse being hand operated by a rack and pinion. It can be set at any angle from 0 to 180° by adjustable stops and an engraved dial on the microscope tube. This slide is also used for radial dressing by stopping it between two centralising stops adjusted initially to bring the diamond into axis with the centre of the microscope. Each setting allows one radial and two straight line motions.

The microscope and dressing unit are mounted on coordinate slides so that they can be brought into position in accordance with wheel diameter and width, and also assist in coordinating various operations to build up a profile $1\frac{1}{2}$ in long. The Optidress has been developed as an auxiliary to the Profiloscope. *Precision Grinding Limited, Mill Green Road, Mitcham Junction, Surrey.*

CAM TIMER

High Switching Capacity



A SWITCHING capacity of 15A at 250V is given by the type ZX synchronous cam timer.

The camshaft speed of the instrument can be between one revolution in three seconds and one revolution in 28 days. At higher shaft speeds smaller numbers of shaft switches can be operated. Slower than one revolution per minute up to 12 switches can be operated without changing the motor.

Each changeover switch is operated by a pair of cams at 180°. Rotation of one half cam relative to the other increases or decreases the effective switch operating arc. Either the normally open or the normally closed side of the switch can be used, giving 360° coverage. Time setting dials are available as an extra. The minimum time interval is approximately one-sixtieth of the total revolution time. For very short time intervals a model with two cam shafts running at different speeds can be supplied.

The standard operating voltage is 220-250V 50 cycles or 400-440V 50 cycles. A d.c./a.c. conversion unit is available. The timer measures $2\frac{3}{4}$ in by $3\frac{1}{8}$ in by $5\frac{1}{4}$ in long when it is fitted with two changeover switches. In addition the timer can be provided with a friction clutch between the motor and the cam shaft, or there can be an external pointer to indicate the progress of the timing cycle. The pointer can be used to rotate the camshaft to any part of the cycle. *Electrical Remote Control Company Limited, Elremco Works, Harlow New Town, Essex.*

Concluding

Letters to the Editor

basis of present theories of semiconductors to believe that it will not be possible to make any material with ZT greater than 3. Curves corresponding to this value of ZT are also plotted on the accompanying diagrams, and it can be seen that, even if intensive research could produce a material to approach this limit, thermoelectric power would still not be competitive (except for cycle upper temperatures too low to be of interest) on a basis of either efficiency or cost.

The theory of semiconductor thermoelements is still in its infancy and, although one cannot safely predict what new developments may take place in the future, it seems certain that we must aim for a major breakthrough in new materials for thermoelectric power to become economic.

Yours faithfully,

K. H. SPRING,
D. T. SWIFT-HOOK.

Central Electricity Generating Board,
157-168 Blackfriars Road, London, SE1.
28 October, 1959.

SELF-PROPELLED WELL-POINT DRILL

Depths of 250 ft

MOUNTED on a self-propelled vehicle, the Reich 155 drill will drill holes up to 5 in in diameter to depths of 250 ft.

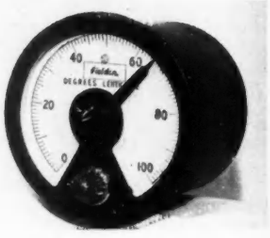
Power is supplied by a Ford three-cylinder diesel engine directly connected to a hydraulic pump which provides fluid power for the rotary drilling head, feed cylinders and the propelling motor. Compressed air which is used for the operation of the down-the-hole hammer and for air flushing of chippings is provided by a CP365-RO-2 compressor which delivers 365 c.f.m. at 100 lb per sq. in. This unit can be towed behind the drill if the ground is suitable.

The variable-speed hydraulic motor is carried on the slides of a retractable mast which can be positioned at almost any drilling angle. A pneumatically operated hammer is located at the end of a string of drilling rods, the hammer being designed for operation with bit sizes of $4\frac{1}{2}$, $4\frac{3}{4}$, and 5 in. The final operating torque is 10,500 in-lb.

The working stroke is 11 ft, and 10 ft lengths of rod are used. Penetration rates up to 45 ft per hour have been achieved and to handle the dust produced a dust-disposal unit is fitted as standard. This consists of a vertical spindle 750 c.f.m. blower fan which is fitted to the drill table and driven by a direct-coupled hydraulic motor. The controls allow for the mast to be swung through an angle of 160° and for the drill table to be brought as close to the collar of the hole as possible. A hydraulic motor driving through a Croft torque arm reducer and roller chain to the back axle supplies the travel power. *Consolidated Pneumatic Tool Company Limited, 232 Dawes Road, London, SW6.*

TEMPERATURE CONTROLLER

High Accuracy



FIRST of a new range of transistorised instruments made by Fielden Electronics is the Bikini temperature controller. It has a differential of only 0·5° C.

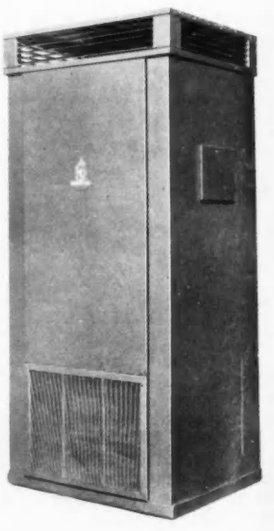
The instrument is housed in a case $4\frac{1}{2}$ in diameter and has a scale equivalent to 9 in. The control pointer is set from the centre knob and a red light indicates control action. The temperature range for control can be anywhere between − 200° C and + 500° C with a minimum span of 50° C. There are 12 standard calibrations in degrees F and C. The instrument is claimed to have high calibration accuracy and also to have very high long-term stability.

A platinum-resistance element is used at the measuring point, housed in a stainless-steel sheath of $\frac{1}{4}$ in diameter. The connecting cable can be up to 20 ft long. The control action is on/off, and either electrical or pneumatic. In both cases the control relay can be located up to 300 ft away from the instrument, only light-duty cable being required.

The electronic circuit is completely transistorised and will operate from a 12 V d.c. supply. An intrinsic safety certificate has been applied for. Only light-duty cabling is needed from the power supply. The electrical contacts give changeover switching for 5 A at 250 V, while the pneumatic valve requires an input of 17 to 20 lb per sq. in. No warming up time is required. Power supply units for use with the mains are available which will feed one or more instruments. It is claimed that the instrument contains no delicate parts and can be mounted on the face of an inclined desk. *Fielden Electronics Limited, Wythenshawe, Manchester.*

OIL FIRED AIR HEATER

Vortex Combustion



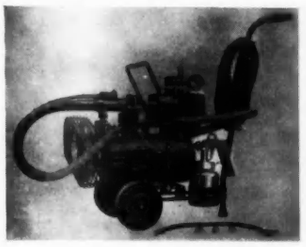
WHAT is claimed to be a new combustion system for an oil-fired air heater has been employed in the Colt Turbo-Static.

Air is forced into the combustion chamber through vaned slots which form two contra-rotating streams of air. Rapid mixing is obtained and the length of the combustion area is reduced to 15 in. A third outer stream forms a barrier layer to prevent the flame impinging on the chamber walls.

The combustion chamber is isolated and insulated from the main air supply by two outer walls through which the combustion air flows. Thus the air is preheated to above the evaporation temperature of the oil mist. Temperatures in excess of 3,000° F are attained in the chamber and sooting is eliminated. The burnt gases pass, in contraflow to the main air supply, through a heat exchanger. The units are being made in three sizes with outputs of 250,000, 350,000 and 500,000 Btu per hour. *Colt Ventilation Limited, Surbiton, Surrey.*

PAINT SPRAYER

With Flexible Drive Power Take-Off



THE PPP power and paint pack is a portable unit, basically for paint spraying but to which has been added a flexible drive for drilling, polishing or grinding.

Power is supplied by a ½ h.p. electric motor running from a 220/250V supply. This drives directly a Compton diaphragm compressor giving oil free air at pressures up to 50 lb per sq. in. The pressure can be adjusted by finger tip control and is indicated on a large scale dial. For general purpose work the type PF pressure feed internal mix gun is recommended but a gravity feed gun is also available. An air filter is fitted to the intake to prevent the ingress of dirt. A 20 ft length of hose is included and extra lengths can be added.

The flexible drive will take a ½ in capacity drill chuck as standard, and all normal work up to this capacity can be carried out. There is a choice of three speeds obtained by step pulleys driven from the motor shaft. These are 710, 1,420 and 2,840 r.p.m. When not in use the flexible shaft is clipped back for safety. The standard length of shaft is 6 ft but longer drives can be supplied to order. A belt guard covers the pulleys, and a micro switch by the chuck gives the operator control for stopping and starting the motor.

The trolley is of all steel construction and has cushion tread rubber wheels giving quiet running. The machine can be removed from the trolley and used separately if required. A separate handle on the compressor is provided for easy lifting. Even tyres can be inflated with a length of hose supplied as an attachment. *Dawson, McDonald and Dawson Limited, Compton Works, Ashbourne, Derbyshire.*

BALANCING MACHINE

Vertical Axis

THE Z34EB is a balancing machine having the axis of rotation vertical, and is designed for the serial balancing of disc-shaped workpieces.

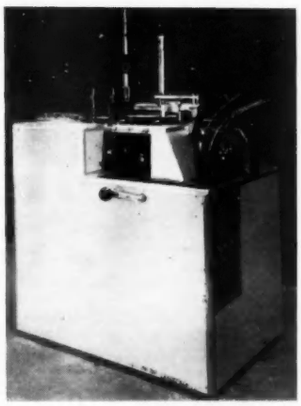
The vertical spindle will take a range of adaptors to suit various workpieces. The advantage over horizontal machines is that the workpiece does not have to be shrunk on to an auxiliary shaft. The operator is unskilled—he has only to position the work to be balanced and to start the machine; the remainder of the process is automatic.

Any unbalance is indicated by a spot of light on the vectormeter dial showing the error both in position and amount. When the automatic control has brought the machine to a standstill the indication remains until the machine is started for the next run. Each run takes from 6 to 10 seconds.

Corrections are made in the usual way by drilling. The operator rotates the disc by hand to the position indicated by the dial and the corresponding scale on the spindle. The drill head is then swung into position and a hole drilled to the depth shown on the scale. A final run gives a check of accuracy. The complete cycle for balancing the flywheel of a passenger car would take about 50 sec, floor to floor timing. *Carl Schenck Maschinenfabrik GmbH, Landwehrstrasse 55, (16) Darmstadt, Germany.*

PLEAT WRAPPER

For Round or Square Packs



THE Watford pleat wrapping machine has been designed to make small picnic packs of round or square products, such as biscuits.

The items to be wrapped are placed in the feed-hopper at the left. From one to eight items are collated and fed on to a conveyor belt to meet the wrapping material. This is drawn tightly over the upper surface of the product and then pleated round the sides. A fold on the under side completes the pack. Prior to heat sealing the final fold, a heat sensitive label can be added to the pack. If it is desired to use specially printed wrapping material to enclose the product it is possible to fit a print registration unit to give accurate location.

The operation of the machine is fully automatic and the controls are arranged on a panel at one end. The operator has full view of the process.

The standard machine has a wrapping rate of up to 45 packets per minute. The maximum size that it can accommodate is a 3 in cube. Power is supplied by a ¼ h.p. motor suitable for all standard voltages. The dimensions of the basic machine are 3 ft by 2 ft ground area and the working height is 4 ft. Attachments available are the print registration unit and the labelling unit. *H and B Precision Engineers Limited, Colonial Way, Station Estate, Watford.*

ACCELERATOR

For Small Bore Heating

THE Small Boar is a glandless accelerator that has been added to the PEP range particularly for use in small bore heating systems.

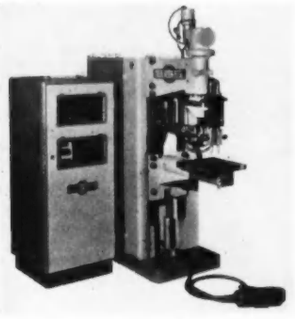
The unit is of the canned rotor totally enclosed type having windings suitable for either single or three-phase supplies. The glandless construction avoids leaks, and it is claimed that the waterways are large enough to allow gravity flow when the pump is stopped. It is also said to be quiet in operation and to require little attention for, as in all glandless types, the bearings are lubricated by the water being pumped.

Standard fittings are for ¾ in, 1 in, or 1¼ in pipes, and the installation can be in either a horizontal or a vertical pipeline, though for highest efficiency the motor should be horizontal. The pump weighs only 20 lb, and so does not need special supports.

Three models are available. The ratings are 100W, 75W and 60W and the corresponding discharges against a head of 2 ft are 12, 10 and 7 gallons per min. Maximum operating heads are 12 ft, 8 ft. and 4 ft respectively. All moving parts can be reached by removing the end cap without having to disturb the pipework. Removing the shaft protection nut at the motor end allows the direction of rotation to be checked and also the shaft to be turned by hand in case of fouling, or if the pump has been idle for a long time. *Precision Electrical Products (Stockport) Limited, Lytham Street, Cale Green, Stockport.*

WELDER

For Plastics Coated Steel



MODEL SAS75 is a special purpose welder that has been developed for use with plastics coated steels.

The projection welding machine has a rating of 75 kVA and is operated on the series principle. Other ratings are available. It is fitted with a fully synchronous electronic control unit which comprises synchronous dekatron timer, phase shift heat control, and an ignitron contactor. This is said to guarantee consistent repeat weld conditions. The range of welding times is variable from infinity to 90 cycles. The unit has a built-in memory device to control the half cycle weld time and to alternate the pulses of unidirectional energy on each subsequent weld. Pulse alternation prevents build-up of d.c. and saturation of the transformer.

Unusual features of the machine include spring loaded electrode assemblies to provide rapid follow up and to ensure full consolidation of the weld nugget. These are individually adjustable for pressure and are provided with micro adjustment mechanisms calibrated to permit critical settings to be accurately repeated.

Tests have shown that the machine can be used satisfactorily with heavily patterned and even simulated leather cloth, in addition to the more regular matt or glossy finished surfaces. Experiments have also shown that plastics surfaced electron zinc coated steels may be welded as readily as the coated mild steel. *Sciaky Electric Welding Machines Limited, Slough, Bucks.*

HAND TORCH

Shockproof and Flameproof

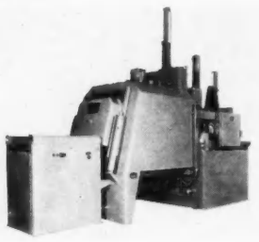
THE BM torch is claimed to be shockproof, flameproof and waterproof.

Two models are made, the Mark I, which is for general use, and the Mark II which has been granted a certificate for group I gases. The switch mechanism is operated by rotating the head and gives choice of three positions—off, flash, and on. Battery and bulb are reached by removing the head which in the case of the flameproof model requires a special spanner. The body of the flameproof model has been coated with nylon to ensure a non-spark surface and non-corrosive materials have been used throughout both models.

The torch has been subjected to stringent tests. It has been submerged to a depth of 120 ft for a week; it has been boiled in a pressure cooker at 40 lb per sq. in for an hour; it has been kept at — 20° F for 48 hours—all without damage; complete with batteries it has been dropped at various angles on to concrete from a height of 15 ft without damage to the case or mechanism but occasional breakage of the bulb. The switch has been given 500,000 operations without showing signs of wear. *Bardic Limited, William Street, Northam, Southampton.*

HEAT TREATMENT UNIT

Sealed Quenching



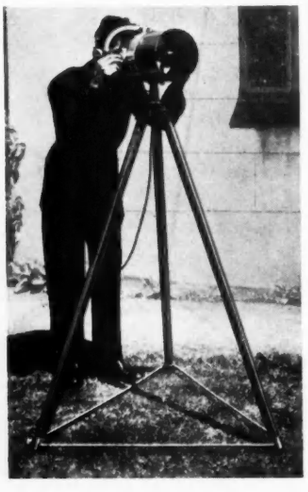
THE Ipsen automatic heat treatment unit is a straight through plant with an atmosphere sealed quench section. It will operate at temperatures up to 1,100° C.

Work that can be carried out includes carburising, carbon restoration, carbonitriding, neutral hardening, marquenching, normalising, annealing and brazing. In operation the work is loaded into an Inconel basket and placed on the roller platform of the loader. Movement into the furnace is first by a cross member in the endless chain drive, then by a hidden extension bar on the same chain drive. The charging door is operated by an air hydraulic system and baffles are arranged to spread the heat over the work load. The atmosphere is circulated by a fan mounted in the roof, the fan itself being made of an alloy ceramic. The driving motor is water cooled so that the bearings are kept below 130° F.

Heat can be supplied by either gas or electricity; alloy ceramic tubes are used in both cases. Transfer from the heating chamber to the quench rack is by two endless chains which only move during the unloading cycle and which are arranged so that the load is taken only by the cold portions. The movement takes about 15 seconds. The quench hood is water jacketed and the water is temperature controlled. The quench elevator is 18 in beyond the door so that oil will not splash back into the furnace during quenching. An air-draulic cylinder lowers the rack into the tank, and the oil is circulated by a shrouded propeller. Furnaces with heating rates from 25 to 2,500 lb per hour are available. *Ipsen Industries Incorporated, 53 Victoria Road, Surbiton, Surrey.*

BOLOMETER

For Locating Hot Spots



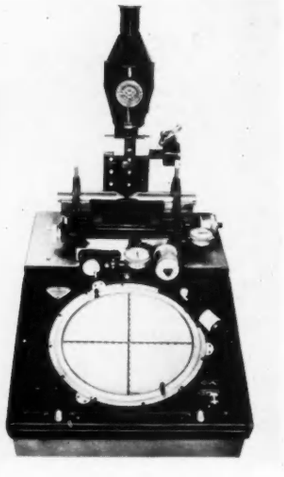
THE bolometer is designed to detect infra red radiation and so to pinpoint objects which are above the surrounding temperature.

The instrument is particularly suited to locating hot spots in machinery or equipment which cannot be closely approached, such as bad joints in high-voltage cables while the power is on. Sensitivity is such that a human body can be easily detected at a distance of 20 ft in a room with an ambient temperature of 25° C (77° F). A ship's funnel can be detected at several miles.

The bolometer is in the form of a cylinder 14 in long and 7 in diameter. The object is viewed through an eyepiece and then focused on the window of the instrument. The infra red radiation falls on a strip of gold leaf about 1 mm wide held across three supports to make two equal arms. These arms form part of a Wheatstone bridge. A scale fitted to the slide wire of the bridge can be calibrated in terms of the energy entering the bolometer. An amplifier is used to give audible indication of the balance point. *H. Tinsley and Company Limited, Werndee Hall, South Norwood, London, SE25.*

VERNIER PROTRACTOR

For Optical Projector



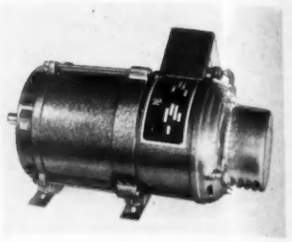
A VERNIER protractor has been produced for use with the Shadowmaster optical projectors. It gives direct readings of 1 minute of arc.

The attachment consists of a rectangular cast frame measuring 15 in by 12 in with a rotatable screen 9¾ in diameter. The main scale ring, which also carries the Shadowline screen, is located by preloaded roller bearings. These are unequally spaced to avoid tracking and wear. The main scale has half-degree divisions numbered at 10° intervals from zero to 180° in both directions. The vernier scale has 14½° divided into 30 divisions thus allowing direct readings in minutes. The vernier scale does not touch the main scale.

The cross lines on the screen are bands of colour so that the thickness of an edge line is not involved. The straight edge is coincident with the theoretical centre line of the protractor and the deckle edge has been chosen to avoid confusion. Since the image can be viewed through these bands they provide what are virtually lines of no width. *Watson, Manasty and Company Limited, 139 Richmond Road, Kingston-on-Thames, Surrey.*

INDUCTION COUPLING

Torque and Speed



THE TASC induction coupling has been designed to give accurate torque and speed control with rapid response.

Basically the coupling consists of a magnetic tube, mounted between end castings, which carries the magnetising coil, an input member which is rotated at a constant speed and is poled, and an output member which is welded to an aluminium boss which in turn is bolted to the output shaft. The connection between input and output shaft is therefore magnetic and not mechanical.

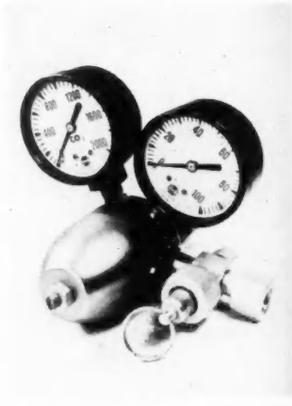
Speed control is effected by fitting a tachogenerator to the output shaft, the signal being used to close a simple speed servo loop. As a result, the response to variations is very rapid, and control over a 20 : 1 speed range is within 3 per cent. Torque is variable independently of speed simply by varying the current input to the magnetising coil.

Chief claims for the coupling are its simplicity, rugged construction and the fact that it can be stalled indefinitely without over-heating. It is as foolproof as a corresponding hydraulic device. The isolation of the shafts means that there is no feed back from the load to upset regulation.

The magnetising coil is bonded in place with Araldite and it is claimed that no maintenance is needed during the whole lifetime. The bearings are sealed. The coupling will be made in a range of sizes from ¼ h.p. up to 10 h.p.; the same control unit is suitable for all. The ¼, ½, and 1 h.p. models will be integrated with an electric motor but the higher powered models will be available as separate units. *Pye Electric Limited, Lowestoft, Suffolk.*

GAS REGULATOR

For Carbon Dioxide Supplies



IMPROVED versions of Linde carbon dioxide regulators are now being marketed.

The models have been designed principally for use with both premix and postmix soda-dispensing plant and include types for controlling carbon dioxide delivery at a single pressure and also regulator manifolds that make it possible to use different optimum pressures for each mix.

The regulators combine a relief valve and check valve assembly. The crack and reseal differential can be preset at any pressure up to 100 lb per sq. in. Liquid flow-back is prevented by a check valve. Fitted to the relief valve is a manual pull ring which makes possible the quick and complete bleeding of the line to relieve the pressure when changing cylinders or regulators.

The bodies of the regulators are solid brass forgings. The diaphragm is a rivetted assembly and all internal parts are interchangeable. The units are available in many different combinations and also made to order for special requirements. They can be fitted with pressure adjusting screws or can have the pressure factory preset. Gauges can be included or not, and the same applies to the relief valves. *Union Carbide International Company Limited, 30 East 42nd Street, New York 17, NY, USA.*

WATER TREATMENT PLANT

135 Gallons per Hour

A DEMINROLIT mixed-bed water-treatment plant is now available in panel form.

The plants are made in two sizes, for 60 and 135 gallons per hour output. The cylinders are 6 in and 9 in in diameter respectively and are housed in free standing units. Mains water passing through is subjected to a vast number of alternating anion and cation exchanges resulting in a demineralised water with a conductivity of less than 1 reciprocal megohm per cu. cm. During the greater part of the operational run, the conductivity is between 0·2 and 0·5 reciprocal megohms per cu. cm.

Each plant is equipped with a built-in multivalve control, a conductivity tester, motorised air blower, and connection tubes of polyethylene. A bottle of the same material is supplied for collecting the output. The cabinet stands 6 ft high by 1 ft 8 in wide, the same size being used for both models. *Permutit Company Limited, Permutit House, Gunnersbury Avenue, London, W4.*

Special Article

Four Years of Management Selection

A valuable body of experience has been built up in the four years since the author's company was founded. Trends in the £2,000 a year and over jobs are now to be reported regularly in the MSL Index, announced this week.

By H. E. Roff, M.A.

Managing Director, Management Selection Limited

In a competitive world, competition is driving companies to make the best use of talent inside their organisation and to acquire the best men for a future whose only certainty is that it will become even more complex. This has led to the creation of the highly specialised branch of consultancy of which Management Selection Limited is a four year old example. We advise on the problems involved in the appointment and employment of technical and managerial staff, whether by internal promotion or by making known the vacancies outside. Advice on salaries, on selection methods and similar problems form part of the total picture.

Like other advisers in special fields of management, selection consultants do not exist to take ultimate decisions. It is for the top management in the particular firm to exercise the function of managing and to make the effective choice. 50,000 advertisements for about 19,000 positions, all about or above the £1,000 a year level, have appeared in six newspapers in 12 months; this is sufficient evidence of the need for executive material and it underlines also, the national need for its effective deployment.

Much has been learned from the hundreds of appointments and thousands of applicants passing through MSL's hands in its four years of life, though we are still learning. The position varies from that where only one man can reasonably be put forward for a particular job to that where, as once happened, hundreds of possible applicants responded to one advertisement.

WHAT THE COMPANY NEEDS

The first move when a company has decided it wants a new executive is to find out a good deal about that company—what does it do, where it sells its products, what its reputation rests upon, what sort of people make up its management team, is it a large impersonal or friendly family business, is the way to the board open to executives or not.

Then follows a careful analysis of its management structure and the men composing it and of the scope and function of the man who is to be found. A lot of frustration and waste can be caused by putting a man with energy and initiative into a position where he is not going to have freedom to act and decide.

A description of the man—in effect a specification of what is wanted—follows. Exact qualifications have not always been thought out; it is easy enough to say "must be a graduate" but does the man filling the job really want to rule out the non-graduate who has exceptional experience? If he does not, then it is wasteful of time and money to say so. More and more companies come to us in these early and flexible stages of considering an appointment. Probing by the MSL consultant and discussion of the answers have occasionally led to a management reorganisation that has made a fresh appointment unnecessary or frequently to re-shaping the appointment.

Inevitably the lessons learned on our scale of operation in dealing with what must be a significant proportion of the country's executive personnel add up to a unique and valuable body of experience on management problems, both of firms and of people.

Most companies prefer, and rightly, to do the bulk of their top job filling by promotion within their own staffs. They still have the problem, however, of choosing the men in the middle grade to move up. Our advice here, has to include not only the manner of the choice, but the form of the promotion ladder and the full employment of executive talent. Inevitably the public image of firms specialising in management selection is biassed to the recruiting side of our work. Since the public sees only the advertisements, which have blossomed out from lines of tiny type into carefully laid out and thought out display advertising, this result is not surprising. They cannot see all the quiet advisory and entirely confidential work that goes on inside the firm before its advertisement is submitted to the newspaper.

It is something like painting a house. Putting on the final top coat looks fun, but getting to that stage requires three times as much preparatory work.

SKILFUL ADVERTISEMENT

But long before a board or a managing director has to make that decision, the consultant handling the case has sat down at his desk and tried, or should have done, to create the advertisement most suited to this especial need. Considerable experience and statistical evaluation of it make it probable that we shall bring in a limited and reasonably suitable field, thus saving everyone, including possible candidates, trouble.

The pitch of a salary, in relation to the experience and qualifications sought, can either retard or accelerate the response. Too low an age bracket could mean that those applying had hardly enough years to acquire the knowledge and experience required; mention of a fairly high age has been known to produce an unexpectedly large number of applications, from men who are often barred by the too rigid barrier of fifty. Achieving the right advertisement is, therefore, no routine task. It has been known to absorb the whole of a wearing morning or even more.

It might be reasonably queried whether the time taken in a long painstaking selection of this kind is time well spent. The sure answer is that any extra cost or extra time is as nothing compared with the all round loss to a company of having the wrong man or simply not the best. No skill or experience can wholly guarantee "the right man," if indeed this is a rational concept at all. It does, however, improve the chance of success materially.

Having said this, it is by no means certain that in most cases more time is taken by calling in a consultant to do the job. Very often a little more time spent in the tool room can avoid production problems and the same applies to deciding exactly what we are looking for before we spend time looking for it.

AND THE MANAGERS?

If these are some of the benefits for the company who call in a management selection service, are there any advantages that come to the applicants, whether they are at the £1,500 to £2,000 a year end of the scale or among the managing directors.

One certain advantage that gradually becomes more and more widely known is that such a service, if it is to exist at all, must have complete integrity. Mistakes, occasional, can be forgiven. No one is ever forgiven for deliberately misleading or betraying a confidence. In addition, selection of client companies is as important as selection of candidates.

With the growth of experience in this field it is less and less probable that an executive changing his job would be sent by a capable consultant to a firm where his managerial skill would be wasted. He certainly always gets an impartial analysis of the situation on which to make up his own mind.

Not entirely surprisingly, it has been found that above a certain level, other incentives than money appear on the scene. The difference between £1,000 a year and £2,000 is the difference between two separate ways of life. The difference between £6,000 and £7,000 a year, tax taking the larger part, is a relatively small matter of degree.

Job satisfaction begins to play an important part here. The satisfaction of being in virtual command of the firm is highly potent and is perhaps as great a target in driving men on to achievement as is the simpler one of financial reward. What a man sees here is a future in which the growth and prosperity of the company (when all team work and group effort have been allowed for) is seen to spring from the major decisions rightly taken by the man at the head.

A SENSITIVE INDEX

Management appointments are not short-term affairs. A sudden rush on the company's product is handled by working overtime, not by appointing a second production chief.

Management appointments are for the long-term and, as such, it may be that managerial and technical movement on a national scale produces an index more sensitive than statistics of materials, orders, manufacturers, stocks or finance. Looked at in this light there may well be here an index not only of activity and investment, but also an indication of confidence in the foreseeable future. It is with this in mind that MSL have introduced the *MSL Index of Executive Employment*, a quarterly analysis of trends in jobs over the £2,000 a year mark.

The place of technical change, allied to the growth of new industries and new departments in the well established, is reflected in the unexpectedly large numbers of appointments advertised in the research and development fields.

The implications for management, right up to its highest levels, are immense. The favoured concept of the last century that "the gentleman manager" could take it in his stride is no longer valid; indeed it was losing ground in some industries, particularly the technical ones, even before the turn of the century.

What does the future hold for management? Management is, and will remain, basically, the management of people. Managers must, therefore, still be those who have enough patience and interest in their fellow human beings to manage them. On the other hand, it will be no use the man with these qualifications saying that he cannot understand all the technical side of the business. If his training is in one particular field, whether it be scientific or not, he must have enough interest and intelligence to understand the virtues and limitations of, for example, computers and of the mathematical and statistical tools which are being put into his hands. He may not have to make the calculations, but he must understand the principles on which the expert works.

This is going to make great demands on selection and on the training of middle management for the higher posts ahead of them. The growing body of expert knowledge, founded on applications and jobs running into the thousands, is there and must make its contribution to the future in seeing that the best fitted men come through to the top. After four years the process is still just beginning; consultants in our own firm with very differing backgrounds are making their contribution to the process of analysing and drawing conclusions from their experience—that of viewing close up a cross-section of the country's best talent, a privilege which they realise brings its own responsibilities.

MEETINGS AND PAPERS

Association of Supervising Electrical Engineers

LONDON
"Marine Propellers," by J. M. Langham. South East London Branch. Eltham Green School, Queenscroft Road, Eltham, SE9. Wed., 11 Nov., 7.45 p.m.
WEMBLEY
"Nuclear Power Stations," by Dr. L. E. C. Hughes. North West London Branch. Century Hotel, Wembley. Mon., 9 Nov., 8.15 p.m.
YORK
"Diesel-Electric Locomotives," by F. H. Woods. York Branch. Georgian House, Blossom Street, York. Tues., 10 Nov., 7.30 p.m.

British Institution of Radio Engineers

LONDON
"Physiological and Acoustical Aspects of Hearing," by Dr. R. P. Gannon. Medical Electronics Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 11 Nov., 6.30 p.m.*
EDINBURGH
"The Transistor and Its Use in Communication and Control Equipment," by E. Wolfendale. Scottish Section. Department of Natural Philosophy, The University, Drummond Street, Edinburgh. Thurs., 12 Nov., 7 p.m.
GLASGOW
"The Transistor and Its Use in Communication and Control Equipment," by E. Wolfendale. Scottish Section. Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C2. Wed., 11 Nov., 7 p.m.
MANCHESTER
"Progress in Permanent Magnet Materials," by J. E. Gould. North Western Section. College of Technology, Sackville Street, Manchester. Thurs., 12 Nov., 6.30 p.m.

Illuminating Engineering Society

LONDON
"Research in Phosphors," by A. H. McKeag. Federation of British Industries, 21 Tothill Street, SW1. Tues., 10 Nov., 6 p.m.
MANCHESTER
"Lighting for Production," by W. R. Stevens. Manchester Centre. Free Trade Hall, Manchester. Thurs., 12 Nov., 7 p.m.
NOTTINGHAM
"Illuminated Ceilings," by W. J. Walpole. Nottingham Centre. Electricity Centre, Carrington Street, Nottingham. Thurs., 12 Nov., 6 p.m.

Institute of Marine Engineers

LONDON
"Design of a Resonance Changer to Overcome Excessive Axial Vibration of Propeller Shafting," by Commander A. J. H. Goodwin. Tues., 10 Nov., 5.30 p.m.*
"Atomic Energy," by K. Maddocks. Junior Lecture. East Ham Technical College, E6. Tues., 10 Nov., 7.15 p.m.
BRISTOL
"Automatic Boiler Control," by P. A. Gill. West of England Section. The University, University Walk, Bristol 8. Mon., 9 Nov., 7.30 p.m.
GLASGOW
"Notes on Development, Design and Operation of Harbour and Coastal Tugs," by R. Beattie. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Wed., 11 Nov., 7.30 p.m.

Institute of Metal Finishing

LONDON
"Pretreatment Methods and Choice for Organic Finishing," by D. H. Lloyd and N. J. Heslop. Organic Finishing Group. British Institute of Management, 80 Fetter Lane, EC4. Wed., 11 Nov., 6.30 p.m.

Institute of Road Transport Engineers

BIRMINGHAM
"Air Suspension," by V. E. Gough. Midlands Centre. Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham. Tues., 10 Nov., 7.30 p.m.
CARDIFF
"Transport Painting," by E. J. Robins. South Wales Centre. South Wales Institute of Engineers, Park Place, Cardiff. Fri., 13 Nov., 7.15 p.m.
EDINBURGH
"Diesel Power Units," by D. Kaberry. Scottish Centre. North British Hotel, Princes Street, Edinburgh. Mon., 16 Nov., 7.30 p.m.
LIVERPOOL
"Air Suspension," by V. E. Gough. West Regional Centre. Liverpool Architectural Society, Bluecoat Chambers, School Lane, Liverpool. Mon., 9 Nov., 7.30 p.m.

Institute of Welding

LONDON
"Welding and Lloyd's," by G. M. Boyd. South London Branch. 54 Princes Street, SW7. Wed., 11 Nov., 7.30 p.m.

Institution of Civil Engineers

LONDON
"Planning for the Ultimate Hydraulic Development of the Nile Valley," by H. A. W. Morrice and W. N. Allan. Tues., 10 Nov., 5.30 p.m.*
"Track Maintenance and Renewal, with Particular Reference to Length of Possession." Informal Discussion introduced by F. Fawcett and W. F. Beatty. Thurs., 12 Nov., 5.30 p.m.*

Institution of Electrical Engineers

LONDON
Various papers on amplifiers. Electronics and Communications Section. Mon., 9 Nov., 5.30 p.m.*
"Generator/Motor Problems in Pumped-Storage Installations," by Dr. J. H. Walker. Supply Section. Wed., 11 Nov., 5.30 p.m.*
"Submersible Pumping Plant," by H. H. Anderson and W. G. Crawford. Utilization Section. Thurs., 12 Nov., 5.30 p.m.*
BELFAST
"Provision of Adequate Electrical Installations in Buildings," by C. C. Hyams. Northern Ireland Centre. David Keir Building, Queen's University, Stranmillis Road, Belfast. Tues., 10 Nov., 6.30 p.m.
BRISTOL
"Subscriber Trunk Dialling," by D. A. Barron. Western Centre. Electricity House, Bristol. Mon., 9 Nov., 6 p.m.*
EDINBURGH
"A New Method for Observing the Phenomena of Commutation," by H. J. H. Sketch, P. A. Shaw and R. J. K. Splatt. South East Scotland Sub-centre. Carlton Hotel, North Bridge, Edinburgh. Wed., 11 Nov., 7 p.m.
LIVERPOOL
"Provision of Adequate Electrical Installations in Buildings." Various papers. Mersey and North Wales Centre. Bluecoat Chambers, School Lane, Liverpool. Mon., 9 Nov., 3 p.m. and 6 p.m.
NEWCASTLE UPON TYNE
"Electrical Supplies to Power Station Auxiliaries," by D. A. Dewison. North Eastern Centre. Neville Hall, Westgate Road, Newcastle upon Tyne. Mon., 9 Nov., 6.15 p.m.
SALISBURY
"Planning and Installation of a Television Transmitting Station," by D. B. Weigall. Southern Centre. Southern Electricity Board's Showrooms, 17 New Canal, Salisbury. Wed., 11 Nov., 6.30 p.m.
WORCESTER
"Deltic Locomotive," by C. M. Cock. South Midland Centre. Victoria Technical College, Worcester. Tues., 10 Nov., 7.30 p.m.

Institution of Engineering Designers

NEWCASTLE UPON TYNE
"Micro Switch Development and Design," by B. A. Holden. North East Branch. Rutherford College of Technology, Northumberland Road, Newcastle upon Tyne. Mon., 9 Nov., 7.15 p.m.

Institution of Gas Engineers

LONDON
"The First Year at the Coke Research Centre," by G. W. Lee. Joint Meeting with the British Coke Research Association and the Coke Oven Managers' Association. Institution of Civil Engineers, Great George Street, SW1. Wed., 11 Nov., 2.30 p.m.

Institution of Heating and Ventilating Engineers

LIVERPOOL
"Some Aspects of Industrial Radiant Heating," by P. A. Coles. Liverpool Branch. Exchange Hotel, Tithebarn Street, Liverpool. Wed., 11 Nov., 6.30 p.m.

Institution of Mechanical Engineers

LONDON
"Vehicle Head Lamp Beam Control," by K. R. Jones; and "Measurement of Driver Visibility and its application to a Visibility Standard," by R. A. C. Fosberry and B. C. Mills. Automobile Division. Tues., 10 Nov., 6 p.m.*
"Extreme Pressure Lubricants for Marine Gears," by A. D. Newman. Lubrication Group. Wed., 11 Nov., 6 p.m.*
"Pipe and Tube Welds on Site." Steam Group Discussion. Thurs., 12 Nov., 6 p.m.*
DUNDEE
"Jodrell Bank Radio Telescope," by H. C. Husband. Scottish Branch. Technical College, Dundee. Thurs., 12 Nov., 7.30 p.m.
EDINBURGH
"Jodrell Bank Radio Telescope," by H. C. Husband. Scottish Branch. North British Hotel, Edinburgh. Fri., 13 Nov., 6.30 p.m.
LEEDS
"Vertical Take-off by Jet Lift," by D. Keith-Lucas. Yorkshire Branch. The University, Leeds. Thurs., 12 Nov., 6.30 p.m.
MANCHESTER
"Reduction of Engine Noise," by A. J. King. North Western Branch. Engineers' Club, Albert Square, Manchester. Thurs., 12 Nov., 6.45 p.m.
SOUTHAMPTON
Editor of one of the motor industry's technical journals will open a discussion. Southern Branch. Polygon Hotel, Southampton. Thurs., 12 Nov., 7.30 p.m.

Institution of Plant Engineers

BRISTOL
"Developments in the Gas Industry," by Dr. W. A. Simmonds. Western Branch. Grand Hotel, Broad Street, Bristol. Wed., 11 Nov., 7.15 p.m.
GLASGOW
"Nuclear Power," by Commander F. A. Walker. Glasgow Branch. Scottish Building Centre, 425 Sauchiehall Street, Glasgow. Thurs., 12 Nov., 7.15 p.m.
MANCHESTER
"Oil Firing of Industrial Boilers," by Dr. H. A. Cheetham. Manchester Branch. Engineers' Club, Albert Square, Manchester. Tues., 10 Nov., 7.15 p.m.
NEWCASTLE UPON TYNE
"Glass," by E. L. Luckner (with films). North East Branch. Roadway House, Oxford Street, Newcastle upon Tyne. Thurs., 12 Nov., 7 p.m.
SCUNTHORPE
"Role of the Central Engineering Workshops in the Maintenance Problem," by G. C. Oram. Sheffield Branch. Blue Bell Hotel, Scunthorpe. Thurs., 12 Nov., 7.30 p.m.

Institution of Production Engineers

LONDON
"Manufacture of Precision Ball and Roller Bearings," by T. J. Williams. London Graduate Section. Wed., 11 Nov., 7.15 p.m.
ACCRINGTON
"Metrology and Industrial Measurement," by P. W. Harrison. Preston Section. Accrington College of Further Education, Sandy Lane, Accrington, Lancs. Wed., 11 Nov., 7.30 p.m.
DONCASTER
"Operational Research," by D. Hicks. Doncaster Section. Doncaster Technical College, Doncaster. Tues., 10 Nov., 7 p.m.
IPSWICH
"Higher Education with Particular Reference to Production Engineering," by F. Metcalf. Eastern Region. Golden Lion Hotel, Cornhill, Ipswich. Fri., 13 Nov., 7.30 p.m.
SHEFFIELD
"Prestressed Rolling Mill," by W. Udall. Sheffield Section. Grand Hotel, Sheffield. Mon., 9 Nov., 6.30 p.m.

Institution of Structural Engineers

LONDON
"North Western Gas Board's New Coal-Carbonising Plant at Garston," by H. G. Cousins. Thurs., 12 Nov., 6 p.m.*

Junior Institution of Engineers

LONDON
"Electronic Components," by the chairman, W.C.C. Ball. Fri., 13 Nov., 7 p.m.*

Liverpool Engineering Society

LIVERPOOL
"Vision and Position: Two Electronic Aids to Marine Navigation," by Dr. R. B. Mitchell and C. Powell. Joint Meeting with the Mersey and North Wales Centre of the Institution of Electrical Engineers. Wed., 11 Nov., 6 p.m.

North East Coast Institution of Engineers and Shipbuilders

NEWCASTLE UPON TYNE
"Ship Model Size and Tank Boundary Correction," by A. Emerson. Neville Hall, Westgate Road, Newcastle upon Tyne. Fri., 13 Nov., 6.15 p.m.

Royal Aeronautical Society

LONDON
Agricultural Aviation Group. Cranfield International Conference. General Discussion. Fri., 13 Nov., 7 p.m.

Royal Society of Arts

LONDON
"Education for Industry and Commerce," by A. A. Part. Cantor Lecture. Mon., 9 Nov., 6 p.m.

Sheffield Metallurgical Association

SHEFFIELD
"Silicon Carbide and Other Super-Refractories: Recent Developments," by C. Presswood. Refractories Group. BISRA Laboratories, Hoyle Street, Sheffield 3. Tues., 10 Nov., 7.30 p.m.

Society of Chemical Industry

LONDON
Heavy Organic Chemicals Group. Inauguration Meeting. "Production of Bulk Organic Chemicals," by D. G. Smith. Thurs., 12 Nov., 6 p.m.

Society of Instrument Technology

LONDON
"Optimum Setting of Water Turbine Governors," by H. Schiott. Control Section. Manson House, 26 Portland Place, W1. Thurs., 12 Nov., 7 p.m.*
BIRMINGHAM
"Ultrasonic Inspection Techniques," by W. B. Emms. Midland Section. Gosta Green College of Technology, Aston Street, Birmingham. Fri., 13 Nov., 7 p.m.
LIVERPOOL
"Data Processing." Discussion. Liverpool Section. MANWEB Industrial Development Centre, Paradise Street, Liverpool. Thurs., 12 Nov., 7.15 p.m.
MANCHESTER
"Transistors," by S. S. Goldburg. Manchester Section. Central Library, St. Peter's Square, Manchester 1. Tues., 10 Nov., 6.45 p.m.
MIDDLESBROUGH
"Analogue Computers," by R. E. Hare. Tees-Side Section. Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. Thurs., 12 Nov., 7.30 p.m.

West of Scotland Iron and Steel Institute

GLASGOW
"Metallurgical Aspects of Flat Rolled Products," by A. J. K. Honeyman. Fri., 20 Nov., 6.45 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. Particulars for this feature should reach the Editor at least three weeks before the date of the meeting.

* An asterisk is placed where it is understood that refreshments are available prior to the time stated.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London, WC1. (LANgham 5927)
British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institute of Metal Finishing. Apply to 11A Gloucester Road, London, SW7. (KNIghtsbridge 9181)
Institute of Road Transport Engineers, 69 Victoria Street, London, SW1. (ABBey 6248)
Institute of Welding, 54 Princes Gate, Exhibition Road, London, SW7. (KNIghtsbridge 8556)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847)
Institution of Gas Engineers, 17 Grosvenor Crescent, London, SW1. (SLOane 8266)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool 2. (Central 3717)
North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle upon Tyne 1. (Newcastle 20289)
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Chemical Industry, 14 Belgrave Square, London, SW1. (BELgravia 3681)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
West of Scotland Iron and Steel Institute, 39 Elmbank Crescent, Glasgow, C2. (Central 5181)

Hours and the ICI

For all the inconsequential furore going on over British Railways' dining cars (if that is the right word) and tugs and half a dozen other strikes, the really significant move came from Imperial Chemical Industries who cut the working week of 60,000 of their workpeople to 42 hours without reducing earnings and without increasing their prices.

A little later Yorkshire Imperial Metals followed suit, cutting from 44½ to 42 hours the working week of 6,000 men operating copper plants at Leeds, Liverpool, South Wales, Dundee and Glasgow.

The obvious question that arises is what effect will these cuts have on the engineering employers' reply to the shorter working week claim of the unions, due this month ?

Mr. William Tallon, senior executive member of the Amalgamated Engineering Union, told ENGINEERING:

" I think the ICI move is going to help. It is a sign of the times and ICI are not the only people who have done it. There are the printers and one or two small but significant examples."

Mr. Tallon, who used to be the spokesman for the craftsmen in negotiations with ICI, recalled that some five years ago the company told him they accepted in principle the validity of the arguments for a shorter working week but that the time then was not opportune.

" ICI are not increasing prices because of this, which is what we argued all along—and we say the same can be done in engineering." said Mr. Tallon.

The engineering employers will not exactly surprise the union leaders if they meet the wage claim with a straight " No." If they are as downright on the hours question it will be a shock for some of the opinion which is beginning to form.

Insurance for Motorists

Motor insurance premiums consist of the cash the insurance companies require to pay for the cost of the damage or compensation for injury caused by a road vehicle, and the cost of administrating the policies plus profits for themselves. We are told that the latter do not exist and that in the last three years there has been an aggregate underwriting loss of £10 million. It is important to place this sum in its context: motor premiums of British companies last year amounted to £260 million, compared to £38 million in 1938. The underwriting loss is therefore—taking an average annual figure—about 1·25 per cent. Insurance companies are saying that the cost of claims is rising and that premiums will doubtless have to be raised soon. We are told that the cost of motor insurance in Britain is very low compared with that in other countries and that the motorist gets in fact excellent value for his money.

The case for the motorist is rarely heard, although most of us feel that insurers are not doing (or need not do) so badly. An objective assessment of this situation is badly needed but facts are hard to come by. Nonetheless there is information about the rate of accidents as a proportion of vehicles on the road. It is substantially lower now than it was 20 years ago and decreasing each year, while the amount paid out in premiums is increasing in step with vehicle registrations. Few businesses are backed by law: motor insurance is one of these, for no vehicle can be licensed without third party insurance. Also there are factors which may well affect the costs of insurance companies but are to some extent within their control. Administration is one—and what office could say with any confidence that its costs could not be reduced by, say, 5 per cent by the introduction of more effective methods? Another is the cost of repairs: in too many cases the bill rises when it is " an insurance job " and there is no guarantee that the work is done efficiently.

This is a field where too little is known and too much is assumed. Current research into the causes of accidents may help insurers to determine their premium policy more realistically. Research into the costs of insurance administration (and selling) and of vehicle repairs could help. Even more unfortunately the current trend is for less competition rather than more and as insurance companies are absorbed by others, the dice becomes loaded even more against the insured.

White Collar Wages

The wage demands which engineering employers are facing this year have been completed by the claims of four unions representing the industry's " white collar " workers. These claims incorporate both a substantial wage increase and a reduction in working hours.

The manual unions defined their objectives as £1 a week wage increase and the immediate introduction of a 40-hour week (which the employers estimated would add about £400 million a year to the industry's costs). The white collar unions were much less specific. Only two—the Scientific Workers (who suggested a 10 per cent wage increase) and the Clerical Workers (who asked for increases ranging from 7*s* 6*d* at the age of 17, to 21*s* 6*d* at 21 and over) put a figure on their demands. The others left them at " substantial," and none of the four said precisely how short a working week they would like. White collar workers in engineering spend an average of about 39 hours at their jobs at the moment, and their unions are thought to be aiming at a reduction to 35.

Last year the engineering unions obtained a wage increase of 5 per cent but dropped their demand for a 40-hour week. This year they are more likely to choose the shorter week on which to make their stand. Whichever they elect to do, a substantial increase in the industry's costs could be involved and could constitute a serious threat to its ability to sell successfully overseas where competition continues to increase.

Schools Plan Protest

London projects for primary and secondary schools costing £4·97 million in the next two years have been approved by the Minister of Education. The schools planning sub-committee of the London County Council had asked for the inclusion of projects amounting to £12·3 million spread over three years from 1960 to 1963. They described the Minister's decision as one which " may well cause dismay in the minds of parents and teachers." The sub-committee say that their three year programme was drawn up on the understanding and in the light of the White Paper " Secondary Education for All—A New Drive " and point out that only 40 per cent of the work which should have been started over the next three years will now be started in 1960 and 1961.

The then Minister of Education, Mr. Geoffrey Lloyd, attacked the critics, on the ground that the LCC had asked for " a lot more than they had any business to expect—£12 million over three years or about £8 million for the two years 1960-62." He was of course speaking during the election campaign and much of his criticism was directed at the Socialist majority in the LCC whose " whole policy," he said, " is to promise the earth, regardless of proper national priorities or the country's ability to foot the bill." The schools planning sub-committee concentrated their criticism on the Minister's " cuts " in their proposals for the improvement or replacement of primary schools in unsatisfactory premises. They also point out that the programme for 1959-60 had been cut by nearly 60 per cent and that it is therefore no argument to say that expenditure in 1960 will in fact be twice that in 1959.

The state of primary schools, throughout the country, leaves much to be desired. It is a weakness which is reflected in the later stages in our children's education and one of the more serious shortcomings of our system. In this respect, however, the quality of teaching rather than the premises, appears to be the main factor.

The Typical Director?

Mainly for propaganda purposes, the Institute of Directors has for some time been trying to get an account or impression which it could publish of the typical or average director. It has been concerned, and reasonably, that the image of the company director in the uninformed mind as either a guinea pig or a ruthless tycoon should not go unchallenged. It recently sent a questionnaire to a random sample of its 32,000 members. The preliminary findings of this were published last week.

They may help to dispel a false impression but they do not put very much in its place. The jobs, habits, backgrounds and status of directors are matters which require a good deal of careful explanation—and circumstances are everything. The questionnaire technique of " yes " and " no " may be expected to produce some odd results. According to the findings 64 per cent have business experience as their only profession. Only 14 per cent have a degree. Seventy-five per cent drive themselves to work, 20 per cent use public transport and only 6 per cent have chauffeurs. Most do a full day's work in an executive capacity outside the board room and only 16 per cent are directors of more than four companies. Most work late and take work home. Nearly half work Saturdays. About 60 per cent have a business lunch twice a week. A full report is to be published later this year. It is to be hoped that it will have a good deal to say not only about the percentages of answers but how the answers have been affected by the extent and degree of complexity of directors' responsibilities.

Schoolroom to Deputy Director

Mr. S. Chard has been appointed Deputy Director of Ordnance Factories (Filling) as from October. He took a special degree in chemistry at London University and went into school teaching. He joined the Government service in 1941 as an explosives chemist and in 1943 was put in charge of a plant. In 1945 he took over a process research station and since 1954 he has been superintendent at the Royal Ordnance Factory, Glascoed, Mon.

Safe Week-End at Brighton?

The differing techniques of various industries create particular safety problems, and the methods used in overcoming them are of value to safety officers beyond the borders of each individual firm.

This is recognised in the devotion of the opening session of this year's annual meeting of the Institution of Industrial Safety Officers (6 to 8 November, at Brighton) to a discussion on a safety course for supervisors in which representatives from a cross-section of industries will take part. New industrial safety films will be screened and then discussed at the second, Saturday afternoon, session.

Mr. B. A. Inshaw, head of the industrial safety division of the Royal Society for the Prevention of Accidents, and Mr. B. L. Cornford, division safety officer, plastics division, Imperial Chemical Industries, are jointly presenting a paper on " Training Equipment and Visual Aids." Another ICI man, Mr. Rex Roberts, education officer, sales region, will give the final paper, " Winning Support by the Spoken Word " and the conference will end with an open forum.

Kiloton Ploughshares

AROUND a conference table in Geneva, politicians and their scientific advisers are again at grips with the problem of controlling nuclear explosions, peaceful or otherwise. Quick agreement is unlikely; the methods of detection are imperfect, particularly regarding underground and high altitude tests. In the meantime, except for the French, who plan to explode their plutonium bomb in February next year, it is unlikely that tests will be resumed in view of the world's mood of disarmament. This effectively puts an end to experimentation on the peaceful application of nuclear explosions, once very much in the news. The following is a balance sheet of the consequences.

Peaceful Uses

The application of nuclear explosions to peaceful use is a comparatively new subject and has not fully benefited from open discussion. As a result only a few proposals have so far received serious attention, and even fewer have been tested in practice. It may be expected that with increased experience new fields of application will be found. Applications come into three main categories: earth moving, heat production, and high neutron-flux utilisation; a combination of these is also possible.

Civil Engineering Applications

Moving large quantities of earth by means of explosions is the application that comes most readily to mind. It is also the most dangerous. A 20 kiloton (energy release equivalent to 20,000 tons of TNT) explosion 50 ft underground in sandy soil would make a crater about 2,000 ft diameter and 300 ft deep. The one-third scaling law applies approximately for larger explosions; that is, the dimensions will be proportional to one-third the power of energy release. Creation of harbours and channels,removal of overburden from ore-deposits, ore-crushing and other large civil engineering projects have been mentioned in this connection; while actual plans have been drawn for the creation of a harbour in Alaska. In these applications the radioactive products are not contained but, depending on the conditions of the blast and the energy of the device, may spread into the troposphere—causing local fallout—or the stratosphere—causing global fallout. Fig. 1 shows an underground storage reservoir created in the interspaces of rock shattered by an explosion.

Underground Explosions

Complete containment of solid radioactive matter results from underground explosions where the explosive force does not break the surface. It is the only peaceful application for which experimental results are available from four tests conducted by the United States under project Plowshare. Figs. 2 and 3 show two stages in a typical underground burst. The shock of the explosion vaporises the walls of the rock cavity to a thickness of several feet, and melts the walls for several yards. In a few thousandths of a second the cavity is expanded from an initial diameter of about 10 ft to 55 ft and is filled with steam at 40 atmospheres and 1,500° C. After a few minutes the cavity collapses and the roof caves into a chimney, shown in Fig. 3. In one of the four tests the chimney broke through to the surface, but in no case was there significant release of radioactivity.

Heat Utilisation

A very large proportion of the energy released in an underground explosion is converted into heat, and attempts could be made to recover it either for processes or power production. Fig. 4 shows the vertical temperature distribution in rock five months after the explosion of the 1·7 kiloton device, " Rainier," which had melted some 700 tons of rock at 3,000° F. The quality of the available heat depends on the type of rock in which it is trapped. In the case of Rainier, the water content of the rock was 35 per cent, so that the available heat soon degraded to the saturation temperature of water at the prevailing lithostatic pressure. Much better results are expected from projected explosions in strata of dry salt near Carlsbad, New Mexico. Molten salt with a melting point of 1,440° F, is a readily exploitable heat source very similar in character to the Italian and New Zealand geothermal sources. A 1 kiloton device releases 10^{12} calories of energy, but no estimate of the efficiency of recovery is available.

Oil Production

The production of oil from the shale deposits of Colorado or the Athabascan tar sands with the aid of nuclear explosions has received some attention, and T. F. Gaskell made a thoughtful evaluation of its possibilities in a recent issue of *Petroleum Times*. In all methods of oil extraction suggested by the US Bureau of Mines the contribution of the nuclear device is mainly in preparing the rock for underground partial combustion of the oil-bearing formations. The " chimney " of the explosion cavity could be used as a retort, or combustion could be initiated along a cylindrical wall around the chimney. In either case the process tends to be inefficient owing to the need to heat the rock or sand as well as the oil. Gaskell estimates that an equal amount of oil would have to be burnt as that extracted, and does not believe that the process has much future.

Ultrafast Breeder

A nuclear explosion is a formidable source of fast neutrons. The number of fission events during the few microseconds duration of an explosion is comparable to that produced in a " good sized chain reacting pile operating for several months or a year " (W. E. Libby, USAEC Commissioner, 5 March, 1959). The liberated fast neutrons can be put to use in a number of ways, both military and civilian. The production of radioisotopes is an example; if the nuclear device were exploded in water-soluble strata such as salt, the recovery of isotopes could proceed simultaneously with heat extraction. The walls of the cavity could be lined with concentrated uranium ore which would serve as a breeder blanket in an enrichment process considerably cheaper than gaseous diffusion. The method would raise the efficiency of utilisation of the exploding device itself in which only a fraction of the critical mass undergoes fission at detonation. The unfissioned material could be recovered along with the breeder blanket. Other important isotopes which could be produced by placing suitable targets around the device are tritium, plutonium and uranium-233, and most of the tracer-isotopes currently used in industry. If isotope recovery were used in conjunction with heat extraction, an industrial complex based on nuclear explosions could be highly economical.

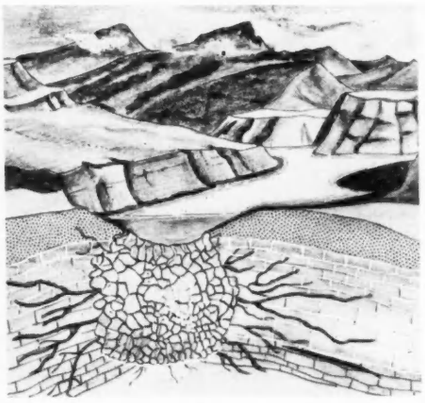


Fig. 1 Underground storage reservoir in shattered rock created by a nuclear explosion.

Research Applications

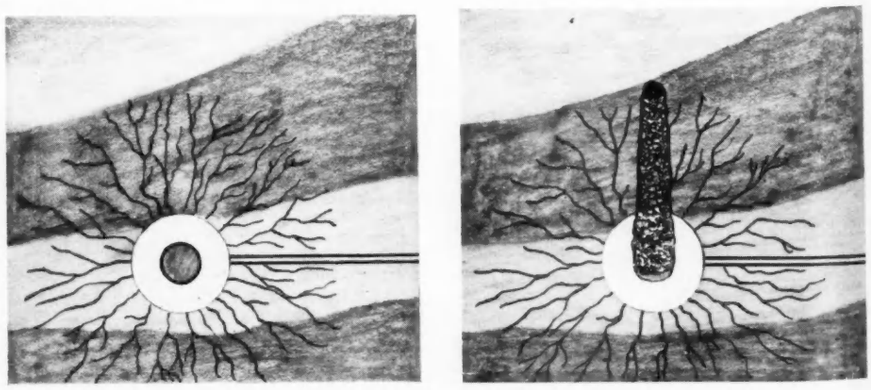
With the exception of Hiroshima and Nagasaki, every explosion so far fired has in a way been a form of research. Among peacetime explosions of particular interest were the two " Hardtack " shots, Teak and Orange, conducted in the Pacific in the summer of 1958, and the three " Argus " tests in the autumn of the same year. The devices were exploded at altitudes ranging from about 190 to 380 miles. Teak and Orange proved that high altitude nuclear explosions can be used to disrupt radiocommunication over an area extending at least 1,500 miles radius. The disruption was attributed to modification of the ionosphere by electronic interference. The interference persisted for a considerable time, and in the case of Orange—fired just before midnight—reached maximum only after sunrise. It is believed that the sun's radiation caused photodissociation of the remaining negative ions which absorbed the lower layers of the ionosphere. The Argus experiments were designed to test theories put forward by N. Christofilos of the University of California under the Geophysical Year programme. The electrons liberated in the explosion were trapped by the earth's magnetic field, creating an electrically charged shell that persisted for several days. The satellite Explorer IV was used to map the intensity and shape of the field to distances of several times the earth's radius.

Neutron Flux from Nuclear Explosions

Nuclear explosions have been used by workers from the Los Alamos Scientific Laboratory as an intense source of neutrons. Using a wheel rimmed with uranium 235 and rotated behind a slit during detonation, they set out to demonstrate that fission of uranium in a high neutron flux occurred more symmetrically than in fluxes obtainable using nuclear reactors. Before a complete revolution of the wheel the slit was closed and the exposed region of uranium was analysed to determine the fission product distribution. The tests appeared to confirm the existence of two classes of fission.

Adding Up the Score

The last known nuclear explosion was set off by the Russians in November, 1958. The next one, if things go according to plan at Marcoule and in the Sahara, will be held by France in February next year. Following that, China appears to be the likeliest to make an attempt, her determination to possess nuclear weapons has been aired repeatedly. Reactors capable of producing limited amounts of plutonium are operating or under construction in several other countries—Japan, Italy, Germany, Sweden and Switzerland to mention a few—and the decision to produce a bomb could be taken by any government. The need to test such weapons would have far reaching effects for the world. The table shows estimated total yields—both fission and fusion—of all types of tests conducted from 1945 to date. The total energy release—91,460 kilotons—is about the same as the heat produced in a 500 MW (e) station in six years of continuous operation.



Figs. 2 and 3 Sequence of events in an underground burst. Vaporisation of the cavity wall is followed by collapse of the " chimney " to a height of some 400 ft.

Yield of Nuclear Explosions in Kilotons

Period	USA and UK	USSR	Total
1945–1951 ..	700	60	760
1952–1954 ..	37,000	500	37,500
1955–1956 ..	9,200	4,000	13,200
1957–1958 ..	19,000	21,000	40,000
Total ..	65,900	25,560	91,460

Carbon 14 Yield from Explosions

Recent estimates of carbon 14 production in nuclear explosions of all types indicate that the amount produced is roughly proportional to the energy release of the weapon, regardless of type. In air-burst explosions approximately 2×10^{26} atoms are produced per megaton of total energy release, including both fission and fusion effects. For surface bursts the yield of carbon 14 is roughly halved owing to the higher probability of neutron absorption in materials other than nitrogen. Expressed in alternate units, the yield is 0·02 megacuries, or 4·7 kilograms of carbon 14 per megaton of energy release.

Atmospheric Radioactivity from Bomb Tests

The results of a study of atmospheric carbon 14 and tritium content, conducted by the Argonne National Laboratory between 1953 and 1958, have now been published. Atomic weapons testing has raised the carbon 14 content to four and a half times, and the tritium content to four times the natural level in the stratosphere. In contrast, in the troposphere, which contains 85 per cent of the earth's atmosphere, the carbon 14 level has only been raised by 15 per cent, while the tritium content has not changed appreciably. The carbon 14 content of the entire atmosphere is now estimated to be 3,200 lb, of which 1,300 lb is a result of weapon testing.

Controlling Mechanisms

The controlling mechanisms of radioactive content in the lower atmospheric region which is of immediate biological interest, appear to be the filtering of active matter from the upper regions into the troposhere, and its removal from the troposphere by rain and other forms of precipitation. A large portion of the active matter washed from the troposphere finds its way into the oceans, where the probability that both tritium (a hydrogen isotope) and carbon 14 will be exchanged for their inactive isotopes is high.

Atmospheric Mixing

Atmospheric mixing of radioactive matter is incomplete. The northern hemisphere, where most of the tests occured, has a much higher concentration of radiocarbon than the southern half. Following a series of atomic tests, clouds of carbon 14 were detected over Minneapolis six months later, and over Sao Paolo 16 months later. If the mixing of artificially produced carbon 14 in the entire global reservoir were complete, the natural background would only be raised by 1 per cent by all the weapons tested from 1954 to 1958. Owing to incomplete mixing, the actual rise in radiocarbon content has been 3 per cent per year over the same period.

Mortality and Genetic Mutations

The department of atomic energy of the Government of India has published a treatise *Nuclear Explosions and Their Effects*. It is established beyond doubt that genetic mutations occur naturally or may be induced by ionising radiation; that " mutation of genes normally present in a species almost invariably exert a deleterious effect on the individual carrying them "; and that " harmless mutations are an exception and beneficial ones rarer still." In a population of 5,000 million 0·7 to 3 million major genetic defects occur annually from natural causes. Most of the stricken organisms do not survive the foetal stage and are eliminated from the population. If nuclear weapon tests were not resumed, the existing fall-out radiation would add from 0·002 to 0·1 million major genetic defects over a period of years. If weapons testing were resumed on the previous scale, the additional defects would be up to 0·04 million annually.

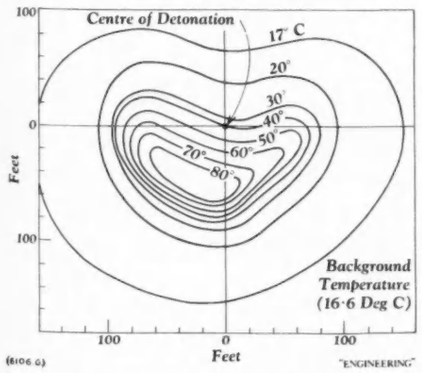


Fig. 4 Vertical temperature distribution five months after the 1·7 kiloton Rainier test in rock.

Cheating the Detectors

The possibility of artificially reducing the magnitude or altering the characteristics of seismic signals from underground explosions was discussed at the Geneva conference on disarmament during the previous session. It is known that the technique of " seismic decoupling " can reduce the signal intensity by a factor of ten or more, and the Plowshare tests indicated that with present measuring methods underground nuclear explosions of considerable power might go undetected. By carefully selecting the site of a proposed weapons test with respect to geology and location relative to detection stations, it might be possible to disguise a nuclear explosion as a small earth tremor. As a result, direct inspection of suspected test-sites remains the only effective control measure with present knowledge and instrumentation.

Underground Explosions by UKAEA

The UKAEA will fire small charges of conventional explosives in a disused Cornish mineshaft in order to test detection methods for underground nuclear explosions. The tests will take place in two or three months time and the information gathered will supplement the results obtained from similar experiments in America. The USAEC is planning to detonate conventional charges in a Louisiana salt mine and monitor the seismic signals on the surface and from locations inside the mine. The American tests will have a maximum power of about 5 tons of TNT, while the UKAEA shots will be much smaller, possibly using only 50 lb of explosive.

Laugh While You Can

The following is a selection of items that appeared in the American magazine *New Yorker*, described as the paper's " fever chart of the planet Earth, showing Man's ups and downs in contaminating the air, the sea, and the soil."

If you wish to live in a suburb of Denver and have seventeen thousand five hundred dollars, you can buy one of forty houses in Allendale Heights that have fall-out shelters in the basement. The first such house went to a retired army major.

The nuclear blast to open a harbour at Cape Thompson, Alaska, may take place in the spring of 1961. " We think we can contain 80 per cent of the radioactivity in the ground," said Dr. Edward Teller at a press conference held to assure Alaskans of their safety. The Atomic Energy Commission is conducting the experiment primarily as a pilot project, and not because a pressing need for a harbour exists. " Alaska has the fewest and most reasonable people," said Dr. Teller. " Where there are no people, no harbour is needed; where there are people, no explosion is permitted." An odd dilemma.

Tea is the latest atomic-age drink. In Japan, mice that were fed tannic acid stored 30 per cent less strontium in their bones than mice not given the acid. Tea, as Japanese merchants were quick to point out, contains tannic acid. Whether a human bone acts like a mouse bone nobody knows for sure, not even a mouse.

The Voices. Representative Thomas N. Downing, of Virginia, asking that a proposed dumping site for atomic waste be established farther away from worried Virginia bathers: " It is possible they could take it out beyond sight of land and dump it and nobody would know about it." Dr. Roger Revelle: " Man is moving and shaking the great globe itself in spite of himself. We may be disastrously changing the climate." Mayor J. L. Foutz, of Farmington, New Mexico, in the Animas River valley: " We don't know enough about what effects the so-called polluted water is causing. I feel it may possibly have a rejuvenating effect somewhat like Ponce de Leòn's fountain of youth. We have a tremendous birth rate here."

Notes and News

Fuel Element Failure Rate

An impressive record of fabricating and non-destructive material testing methods is the astonishingly low fuel element failure rate achieved at Calder Hall. Of the approximately 10,000 fuel elements that go into each reactor every year, only about four develop a fault in service, or less than 0·05 per cent. This achievement is attributed to rigid inspection and non-destructive material testing methods.

Nuclear Power in Australia by 1965

By 1980 Australia will be generating 1,000 MW of nuclear power, and most base load stations built after that date will be nuclear. Senator W. Spooner, Minister for National Development, made the prediction following a survey by the Australian AEC of the country's conventional power resources and the probable cost of fossil and nuclear fuels. Construction of nuclear power stations by the State Governments is expected to begin around 1965.

Military Atomic Power Plant

A contract for the design and operation of a prototype reactor core test facility, designed to test full-scale cores for military field atomic power plants, has been awarded to Combustion Engineering by the USAEC. The 60 MW(t) facility, to be called Nuclear Test Plant, will be located at the Reactor Testing Station, Idaho Falls. The USAEC has also awarded a contract to Kaiser Engineers to study the application of nuclear power in remote military installations. The company is required to report on recommended types of reactor in the 5 to 40 MW(e) range, evaluate construction methods, and compare costs with those of conventional power generation.

Embrittlement of Pressure-Vessel Steel

The American corporations, General Electric and United States Steel, are to carry out an investigation on the effect of radiation on the ductility and impact strength of pressure-vessel steel. The USAEC estimates that no noticeable embrittlement occurs below a fast neutron exposure of 5×10^{18}, but it is emphasised that dependable experimental evidence is scarce. Besides a study of the changes in the load-carrying properties of steels following irradiation equivalent to that expected during the service-life of a reactor, the American firms also plan to investigate the mechanism of radiation damage to the steel microstructure.

Turret Glove-Box

A new technique developed at Harwell will facilitate the machining of radioactive or poisonous materials requiring multiple operations in glove boxes. The need to transfer the work piece from one glove-box to the next when changing machine tools is eliminated by mounting all tools on a turret inside a very large glove-box. The turret, operated electrically, brings the required machine tool within reach of the operator. For series production several glove positions may be used around the turret provided the machining operations take similar time. Plutonium and beryllium machining are immediate applications of the new technique.

Harwell Course in Radiation Protection

A three month advanced course in radiation protection started at Harwell on 28 October. Although no previous specialised knowledge is assumed, the course aims at a high academic standard and concentrates on fundamental principles rather than protection techniques. The course is attended by some 50 people, predominantly from the UKAEA but also from industry and teaching institutions.

Harwell Course on Control and Instruments

The Harwell Reactor School will conduct a course on control and instrumentation from 1 to 12 February next year. The fee for the course will be 50 guineas exclusive of living costs.

Computer Programme for Hyperfine Structure

A computer programme called Ripple has been developed for the calculation of the hyperfine flux structure (ripple structure) of heterogeneous thin-plate fuel elements. The hyperfine flux disturbance is caused by the heterogeneity of the fuel elements, and may be calculated using the collision theory applied to multizone infinite fuel element plates and a constant epithermal source of flux. Neglect of the ripple structure may introduce reactivity errors of the order of a few per cent; while direct measurement is difficult owing to its smallness. (AERE Report R/R 2425.)

Dominican Republic in Search of a Reactor

The Dominican Republic is seeking advice from the Atoms for Peace Organisation on a projected nuclear research programme which would involve the buying of a nuclear reactor for the production of radioactive isotopes for medicine and agriculture. The reactor would also be used for teaching purposes. The announcement was made by Alfredo Vorshirm, head of the Dominican delegation to the third general assembly of the organisation in Vienna.

Rolling Trials in the Wake of a Typhoon

Roll-damping fins designed by Vosper Limited have been fitted to two large motor yachts. One is the Christina, owned by Mr. Aristotle Onassis. Commander Du Cane was aboard during the trials of both vessels, once in the China Sea passing through the track of a typhoon.

By Peter Du Cane, M.I.N.A., M.I.Mech.E., A.F.R.Ae.S.

The Christina is basically a wartime frigate, HMS Stormont, built in Canada, and is now operated as a private motor yacht by Mr. Aristotle Onassis. There is little left of the original ship except the hull below the water line and the steam machinery and boilers. The whole of the upperworks, as well as the stem and stern, were reconstructed at Kiel by Howaldswerke, and a remarkably attractive and distinctive yacht she is, as may be seen from Fig. 1.

The problem of providing sufficient fin power to offer satisfactory performance in roll damping was somewhat complicated by the knowledge that at full speed with two boilers alight the vessel was capable of some 19 knots, while the cruising speed quite often used by the owner was 12 knots, which is easily obtained with only one boiler alight. Incidentally 12 knots is a speed at which there is virtually complete absence of noise and vibration, due in part, of course, to the qualities of the reciprocating steam machinery, but also to the effective measures taken to eliminate vibration by the technical staff of Olympic Maritime.

Had the higher cruising speed represented the speed at which optimum performance was required, it would have been quite possible to employ only one pair of fins located in way of the main engine room. But for this particular case it was decided that a four-fin installation was desirable. The layout is shown in Fig. 2. The forward fins are both located in the auxiliary engine room and the aft fins in the engine room under the main condensers. Installation here was not easy as a structural pillar visible in Fig. 3 limited the size of the equipment inboard.

Fig. 1 (above) Vosper roll-damping fins have been fitted to the yacht Christina owned by Mr. Aristotle Onassis.

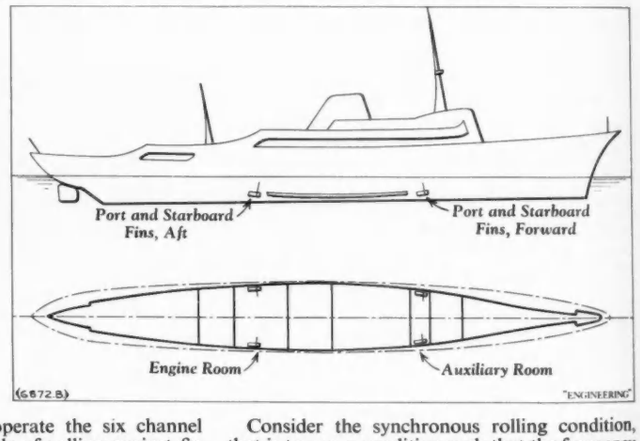


Fig. 2 (right) Layout of the Christina showing the location of the roll damping installations.

It was decided that each fin should be entirely self sufficient as regards gyro, hydraulic pump and other associated items. All these units can be operated from a centrally placed control panel, shown in Fig. 4, located in the engine room in such a position that the chief engineer or watchkeeper can keep an eye on them. The gyros are of Muirhead manufacture. From these panels can be started the hydralulic pumps and gyros, and indicating pointers are arranged to show the angle of each of the fins. Fin movement indicators were also fitted on the bridge.

For these fin operating units, which are larger than have been fitted by Vosper previously, a disc braking system is provided, so that in the event of hydraulic pressure failing for any reason a spring actuating mechanism, which is normally restrained by the pressure, will come into operation and apply the disc brakes, thereby holding the fin until it can be turned by the wormgear provided and "pinned." The installation, in order to avoid the complications involved in retraction of the fins, makes use of a fixed (unretractable) unflapped fin of low aspect ratio, which enables the outreach of the fin to be kept within the maximum beam and draught of the ship. The installation was carried out by the Cantieri del Tirrano at Genoa under the supervision of Vosper Limited.

Sea trials were commenced on Sunday, 28 June, 1959. It was early discovered that there was an element of fouling between the fork ends and the crosshead at extreme angles of incidence. This could have been a serious matter involving possibly the bending of a rod, so it was decided that the necessary metal should be removed from the fork ends. As the ship was by this time at sea, and it was desirable not to return to port, the only workshop facilities for carrying out this work were those available on board. It was an arduous and very hot job, involving eight rams, and one in which the Vosper team were greatly assisted by the ship's engineering staff and the owner's engineering representative, Mr. Dragonas, from head office. It took nearly 24 hours to complete the job, towards the end of which time a gale had blown up pretty quickly, as it is apt to do in the Mediterranean.

This proved a very convincing trial of the fins, because, even though the ship's speed was only seven knots at times in the night, the effect of the fins in reducing rolling was most marked. Unfortunately all concerned were so exhausted by their efforts with the fork ends that we were unable to set up and operate the six channel recorder to obtain records of rolling against fin movement until the next night, by which time the wind and sea had abated. But although we were barely ready for operating the fins that evening of the gale, we switched them on and, hoping for the best, went to bed.

The writer woke during the night at about 02.30 while the gale was still in progress and, after having a quick look round the operating mechanism below, went up to the bridge, where a rather magnificent sea was running, well illuminated by a full moon. Permission was sought to alter course to try to put the ship on a worse course *vis-à-vis* the waves, as it seemed the wave direction of approach was somewhat before the beam, but it made but little difference to the rolling motion, which was almost non-existent. All concerned seemed much impressed.

Forced rolling, which is discussed below, was therefore all we could manage to record. This was carried out on the morning of 1 July, first on the forward fins alone and then on the aft fins. Finally we operated all four in forced roll when the amplitude of roll was built up to such an extent that it was very necessary to shut down before maximum rolling amplitude had been reached. It was realised that by virtue of the rather exceptional fin power in this ship, the rolling amplitudes could be very severe under these circumstances. It was, therefore, arranged that the Captain would inform the writer when he thought matters were getting a bit out of hand. It was then only necessary to "dial" the number of the engine room on the internal telephone and at the first sound of the bell in the engine room the fins could be switched off from the control panel. However, the only casualty reported was the maid who had been cleaning the owner's large Grecian bath and who managed to slip and fall in, thereby becoming completely immersed. She appeared soaked to the skin but happy.

This matter of "forced rolling," so called, consists in reversing the sense of the output signal from the gyro so that, in effect, when the gyro detects a rolling velocity, instead of giving a signal leading to a fin movement likely to produce a moment in the direction required for roll reduction, it produces a moment in the direction for building up a roll. Depending on the fin power available and other factors, the roll will continue to build up until equilibrium conditions exist. In most cases this equilibrium condition is realised at about 15° to 20° from the vertical or 30° to 40° "out to out." It is a very good test of a number of things, but is not popular with cooks.

To a reasonable approximation it can also be considered to be a measure of fin performance available in the roll damping sense.

Consider the synchronous rolling condition, that is to say, a condition such that the frequency of encounter of the disturbing waves, usually on or near the beam or quarter, is equal to the natural rolling frequency of the ship. If, for instance, the build-up of normal rolling amounts is, say, 35° "out to out," then if our forced rolling amplitude is just about the same at maximum we can consider the fin installation able to take care of such a situation. In other words, where the ship would be rolling to 17° either side of vertical without the use of fins, this would be reduced by the fins to negligible quantities when the fins were set in motion. This would be the case in theory. In practice this cannot be so as the signal to the fins from the rate gyro is derived from the existence of a rolling velocity. Also there must be some lag in response, so that a reduction to zero cannot be meaningful.

However, as stated above, there is no doubt that, subject to the performance of the control system being satisfactory, and in the absence of excessive "lag" between control signal and response in terms of fin movement, the steady state rolling amplitude achieved in forced roll

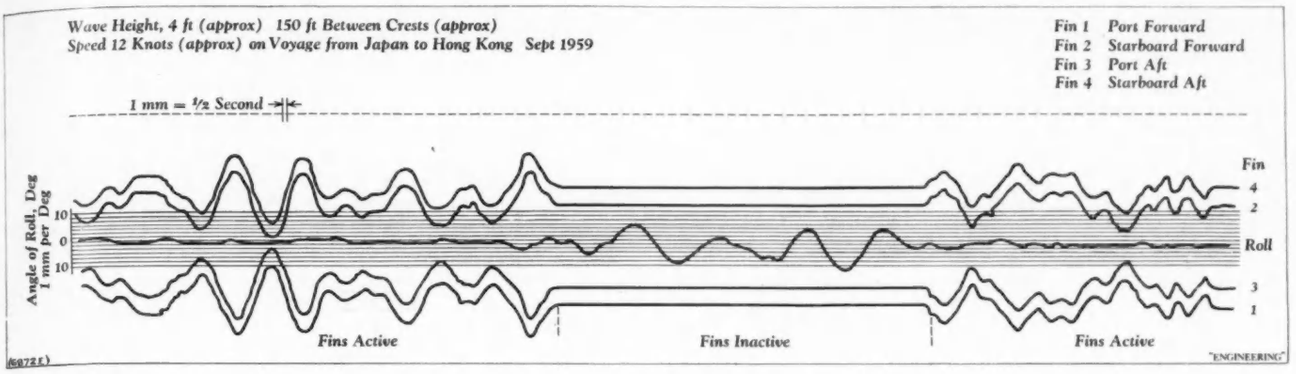


Fig. 5. Recording of fin angles and roll amplitude against time during trial. All four fins follow almost identical pattern of incidence though operated by different gyros.

will be a good indication of system performance from many points of view. It has to be admitted that a really satisfactory means of expressing relative system performance is remarkably difficult. It is quite possible, for instance, to take a sample running record of rolling amplitudes against time over a period and compare the analysis of these records for fins operating as against fins "off." This comparison will produce a so-called "factor of stabilisation" or percentage reduction. A record for a yacht similar to the Christina and referred to below is shown in Fig. 5.

However, in order that this figure can be employed as a criterion for comparison purposes, we must know a number of things about the circumstances in which this performance was achieved. The most important of these is undoubtedly the nature of the wave disturbances which can easily vary considerably between one trial and another. It can well be understood, therefore, that great care must be exercised in judging a system performance on this criterion alone. Taking the limiting case, the stabilisation factor will be zero for the case of a beam sea of any amplitude where the period is either sufficiently short or sufficiently long (frequency of encounter zero or infinity).

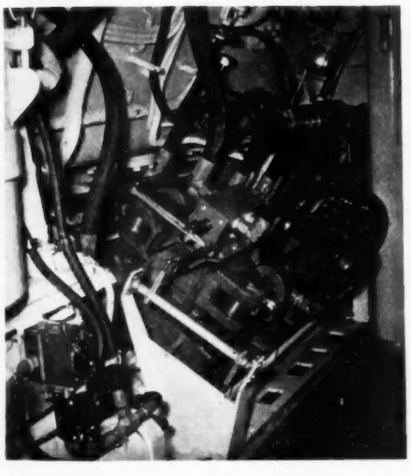


Fig. 3 (left) Interior installation for aft starboard fin.

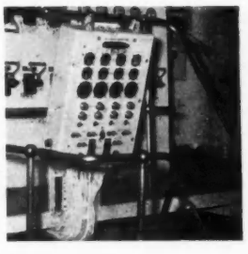


Fig. 4 (right) Roll damping control panel in front of main engine-room switchboard.

On arrival in Monte Carlo after the trials, small adjustments were made to one valve and all was handed over to the chief engineer. We have since been informed that the performance was found to be very impressive by the owner during the course of his cruise to Greece and Turkey with Sir Winston Churchill aboard. Apparently some rough weather was encountered.

ACROSS THE CHINA SEA

Another motor yacht of about 2,000 tons, recently completed in a Japanese shipyard, has also been fitted with Vosper roll-damping fins. The writer and Mr. D. P. E. Shepherd, Vosper representative who stood by during installation, were privileged to be present at the trials and were scheduled to "ride" the ship on her maiden delivery trip to Hong Kong, 1,250 miles to the south. The installation comprises two pairs of fins, as in the Christina.

We were able to carry out a certain number of relatively minor adjustments to hydraulic and control systems during the preliminary trials, and thenceforth had to await a further opportunity for realistic testing during the delivery run from Honshu to Hong Kong. But we were allowed to subject the ship to forced rolling using one pair of fins at a time. As soon as we operated both pairs, the rolling built up rapidly to 40° out to out and would have exceeded this figure had we been allowed to continue.

We were scheduled to sail on Monday, 15 September, but because a typhoon was reported to be coming up more or less on our course, it was felt prudent to wait at anchor. These typhoons are not pleasant and September is about the worst month. This particular typhoon was called "Sarah" and was very fully reported both by the United States Air Force Met. Service at Guam and also by the Japanese in Tokyo. As a matter of some interest, the watching service had tracked the formation and progress of the storm since the beginning of September, when it started thousands of miles away. The trouble was that, although on the Monday when we were ready to sail, Sarah was somewhere in the region of or to the south of Okinawa and could, in the event, have been avoided by sailing out of the Inland Sea straight out about 300 miles to the east, it did not seem quite such a sound policy at the time, as we had no real idea which way the storm would "jink." The probability was that it would take a north-westerly path, but they nearly all turn north easterly eventually, and if the north-east course had been taken too soon we should have been badly caught. The centre of the typhoon was reported as having winds up to 150 knots, which is more than any vessel can compete with, let alone a newly completed motor yacht. We therefore had to wait till it had passed about 200 miles to the north and sailed at 04.00 on the morning of Friday, 19 September.

Though the aftermath of the typhoon left a considerable swell when we were clear of the Inland Sea, during the course of the 4½ days passage to Hong Kong the roll damping fins never really had very much work to do. This was most disappointing in some ways, as we had a multichannel recorder aboard which was able to record rolling amplitudes against time and the movements of all four fins simultaneously. About the best test of the fins took place on Sunday, 20 September, when for a few hours one main engine was stopped for repairs to piping. In these circumstances the fins were much appreciated, more especially as the slow speed accentuated the tendency to roll and it was necessary to move oil drums around the decks.

One of the prime objectives, as far as the writer was concerned, in observing the performance of the roll damping fins during this voyage of 1,250 nautical miles, was to ascertain whether the fixed anti-pitching fins located at the forefoot had any influence on the performance of the forward or either set of roll damping fins. These fixed forward fins were fitted experimentally as a result of investigations carried out at the Davidson Laboratory of the Stevens Institute. As far as could be ascertained from model experiments, there seemed a strong possibility that the pitching amplitudes would be reduced on average by about 20 per cent. What was not quite clear, however, was the extent to which other side effects, such as transverse vibrations, might be introduced. In the event that such vibrations had been introduced to a substantial extent they might possibly have been expected to disturb the hydraulic spool valves on the main rams at least at the forward fin installation. As far as we were able to judge, there was no effect of this nature, despite one or two pitching amplitudes of sufficient magnitude to bring water above the bulwark on to the forecastle. There did not appear to be much effect on the performance of the roll damping fins, though the writer suspects that the directional stability will be found to be affected to some extent.

After a trial period lasting several days and many hundreds of miles we should not be believed if we said there were no troubles or adjustments. But there was not much more than adjustment in the feed back linkage operating spool valves, found to be desirable in the interests of adjusting the working stroke during the initial forced rolling trials. In the course of the delivery "ride" to Hong Kong, the heat was probably partly responsible for a few hydraulic leaks which were attended to. The real "old salts" on board were inclined to say that they liked to feel a ship rolling freely under them. They might have changed their minds had the wave disturbance not been of a relatively minor character for most of the time. It was also observed that the starboard fin (No. 2) was rather "gay," and was always running through about twice the angle of the others in the same time. It was perhaps true that the checking of the roll put a bit of work on the leg muscles when walking about the ship. This effect would disappear in a larger sea. A check on the dashpot in the gyro revealed a substantially different setting to that of the others. It was adjusted from instructions in the Muirhead handbook after arrival in Hong Kong.

LOW COST OIL JETTY FOR SUPERTANKERS

A new form of oil jetty, that will provide facilities for supertankers (65,000 d.w. tons) to be berthed in waters with a large tide range, has been developed during the design and construction of a marine terminal for the Shell Refining Company and the Mersey Docks and Harbour Board at Tranmere on the Cheshire side of the River Mersey, where the tide range is about 30 ft. The construction costs involved are low by comparison with earlier projects.

At Tranmere the terminal will have accommodation for two supertankers, as is shown by the artist's sketch below. Access to the oil stage will be by a forked approach carrying a roadway, footway and the pipe band, as well as sundry services, such as light and power cables, telephone lines and water mains. At each jetty head there is floating stage, 366 ft long by 62 ft wide, with a timber deck laid on a steel framework that includes the buoyancy tanks. Above each stage is the rigid structure of the hose-handling gantry cantilevering over the floating stage; this arrangement means that the only flexible pipe joints are those at the gantry.

The problem of placing the head and stern mooring lines of the tankers has been solved by the development of floating dolphins. It is these dolphins—six are provided for each tanker—that has made it possible to cut the length of the floating stage and so bring about the reduction in cost of the project.

The floating dolphin—illustrated in the drawing—consists of a circular pile, driven into the river bed, which passes through a steel or concrete pontoon of substantial weight and diameter that moves up and down with the tide and carries the mooring bollards. At Tranmere, the pontoons are of steel and have laminated nylon rollers that bear on the faces of the central pile to prevent sticking. They are made in four parts, and when bolted together and ballasted weigh 70 tons; they have a diameter of 25 ft and are free to rotate. The central piles are high tensile steel tubes of 5 ft 5 in diameter made by the Mannesmann Company of Duisberg, Germany. They have been sunk and concreted into 6 ft diameter holes which have been bored 30 ft deep into the sandstone rock of the river bed. Each dolphin will take a horizontal pull of 150 tons applied at highest water. The resilience of the tube also reduces the possibility of a tie parting in the event of a "snatch." By floating, the dolphins also lessen the need for mooring line adjustments.

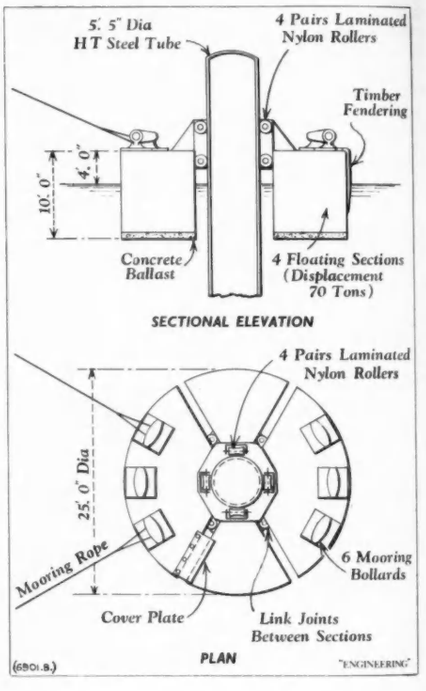
Each floating stage is in fact a large gravity fender, for it is anchored by four 150 ft long steel booms through trunnions and pivot connections to 100 ton ballast boxes suspended between pairs of Mannesmann tubes. As a tanker comes alongside, the staging is forced backwards against an increasing moment generated by the displacement of the ballast boxes. Under wind load and berthing impact the stage can move back as much as 16 ft from its normal low water position; the corresponding displacement of the ballast boxes is 3 ft 9 in backwards and 3 ft 4 in upwards, and the thrust in the booms is 150 tons.

Each end of the stage, acting through a pair of booms was specified to absorb 350 ft-tons of kinetic energy. This is 50 per cent of the energy possessed by 80,000 tons deadweight moving at a berthing speed of $\frac{3}{4}$ ft per sec; the difference was to be taken up by squeezing the water between the hull and the jetty and by the resilience of the hull itself. The anchorage system as a whole can withstand a side wind load of 375 tons, and the jetty can, in fact, absorb 700 ft-tons of energy at either end of each of the stages.

Since the development of the Tranmere project, which is nearing completion, it has been realised that further improvement, leading to greater economies, can be made. In particular, the floating stages now serve only for berthing purposes and can be much smaller. They would become no more than floating booms of reinforced concrete, steel or timber, and could lie to a row of piles or cylinders.

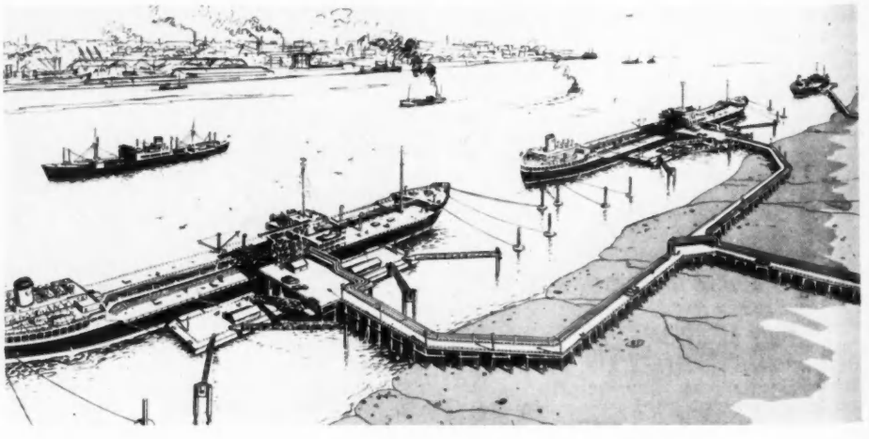
With the simultaneous discharge of two supertankers of up to 65,000 d.w. tons, about 150,000 tons of crude oil can be handled daily. From Tranmere, the crudes will be pumped the 9 miles to the company's refinery at Stanlow.

The main contractors for the jetty and the stages are Peter Lind and Company, Limited, with the Cleveland Bridge and Engineering Company Limited as subcontractors for the steelwork. The project has been developed jointly by the Shell Refining Company and the Mersey Docks and Harbour Board.



Floating mooring pontoon. It will take a horizontal pull of 150 tons and eliminates constant adjustment of the ties where there is a large tidal range.

Artist's impression of the Shell marine terminal at Tranmere. The four anchor booms for each floating stage and the six floating dolphins for each tanker can be seen in the foreground.



INTO THE CAR AGE

On time, and within a contract period of 19 months, John Laing and Son Limited completed the first 55 mile stretch of the London to Birmingham Motorway. Never before in this country has so much plant been assembled on a single civil engineering project: machinery valued at over £5 million and together developing 80,000 h.p.—about 20 h.p. for each operative—was working at the peak period. At one time 30,000 tons of materials were being taken on to the site daily. For the last few months of the contract, the asphalt top surface has been laid at a rate equivalent to three miles of finished motorway a month.

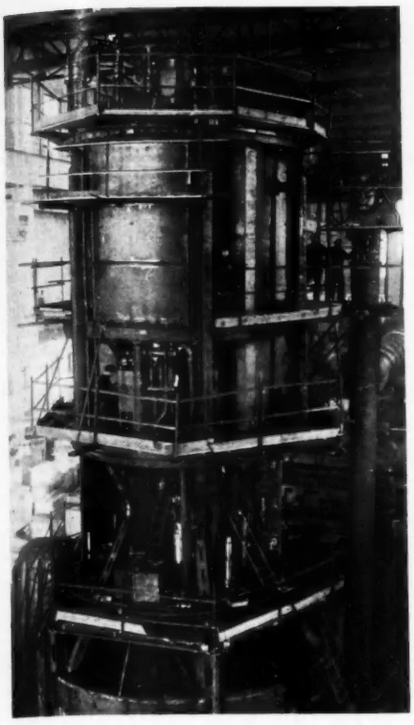
How this work was organised—and the Motorway is a monument to the engineer as an organiser—has already been described in ENGINEERING (11 September, page 175) by Mr. Kirby Laing, chairman of the contractors. The 19 months of the contract period was chosen to contain two summers: the first proved to be the wettest for 47 years and excavation work—11½ million cu. yd—was badly held up; the second was the driest for perhaps 200 years. Of particular note is that not one man-hour was lost by labour disputes on the contract.

To carry the Motorway over roads, rivers, canals and railways, 134 bridges have been built; in addition, seven special road junctions have been constructed to provide access at intermediate points. The bridges have all been built of reinforced concrete and a high degree of standardisation was accepted in the interest of achieving overall economy, particularly in construction time and in long term maintenance. By standardisation, it has been possible to maintain an individual character for a substantial length of highway.

At the southern end of the Motorway, the Cubitts Fitzpatrick Shand consortium have completed part of the Watford leg of the St. Albans bypass two months ahead of time; the remainder will be handed over several weeks ahead of schedule. The bypass is an all-concrete road and it has been described by independent observers as the "finest road surface in Europe." Though the contract was worth only £1¼ million, the contractors had £1 million of plant working on this site.

The consulting engineers to the Ministry of Transport for all the works connected with the Motorway were Sir Owen Williams and Partners of London.

So much for motorways in open country. What has been done, must be done again, even quicker and perhaps better. And, simultaneously, a bold approach must be made to the problems of urban motorways. The contractors, said Mr. Maurice Laing after the lunch given to celebrate the opening of M1, could take all the work the Ministry could give them.



Shaft Sinking Machine

The shaft sinking unit shown in the illustration will sink and line a shaft of 6 m diameter through rock at a rate of up to 1 m per hour. Built for use in Soviet mines, it will be scheduled to complete a shaft depth of 180 m every month.

Known as the PD-1M, the machine has been built by the Central Mine Building Research Institute of the USSR. It is about 17 m high and weighs some 150 tons. Disc cutters are used to loosen the spoil which the machine sends to the surface; the machine also puts concrete lining segments into position. Control of all operations is made from a single desk that is reached through manholes.

Chimneys at Northfleet Power Station

The two reinforced concrete chimneys at the CEGB's new generating station at Northfleet are 500 ft high and are the tallest in Britain.

Built on raft foundations, they are 38 ft internal diameter at the base reducing to 23 ft at the top; the concrete walls are 19 in thick at the base, but only 6 in for the top 175 ft. Khaki coloured cement has been used in the concrete and the tops of the chimneys have been treated with acid resisting paint. The consulting engineers were L. G. Mouchel and Partners and the contractors for the chimneys Tileman and Company Limited.

Tensile Cracks in Reinforced Concrete

A very long series of specimens has been tested at the Laboratoriet for Bygningsteknik, Copenhagen, to determine the cause and distribution of cracks in reinforced and prestressed concrete. The results of the research are published in a report (in English) by Axel Efsen and Herbert Krenchel under the title *Tensile Cracks in Reinforced Concrete*. The authors claim that the number of test specimens available to them has made it possible to eliminate the less important factors and arrive at simple formulae for the distribution and width of cracks.

Two points from the conclusions are that crack spacing is independent of the surface pattern on the steel reinforcement and the bond strength developed; nor, in addition, does the strength of the concrete have any significant influence on the crack formation. Crack parameters have been found for a number of cases.

Vibrations Applied to Precast Concrete

Work is now well advanced in the preparation of a paper to be given by the British delegation at the Stockholm Congress of the International Bureau for Precast Concrete, to be held from 16 June until 20 June 1960.

The title of the paper is to be " The Practical Applications of Vibration for Precast Concrete " and the content is being collated from data received both from within the United Kingdom and abroad, so as to make the paper as comprehensive as possible. The main headings of the paper include an outline of vibratory methods; the influence of vibration on mix; mould design and the quality of the finished product; special problems, controversial points and common errors in the uses of vibration; a brief discussion of current theories and a reference to measuring vibration; and the consistency of the end product.

A considerable amount of information has already been amassed but the authors would welcome further contributions which should be sent to Mr. Eric F. Wettern, at 56 Dingwall Road, Croydon, Surrey, who is acting as reporter on behalf of the British Cast Concrete Federation.

Aluminium versus Steel for Welded Beams

Tests on welded beams of conventional design made of mild steel and of aluminium alloy (NP/56) have shown that the light alloy beam is as structurally efficient as its steel counterpart and that considerable saving in weight can be effected by the use of aluminium. Small reductions in weight can also be made by reducing the depth at the ends.

The tests, which were conducted on full-size hatchway beams of 16 ft span and 16 in deep at mid-span, were undertaken by the British Shipbuilding Research Association and are reported at length in paper No. 1251—" Steel and Aluminium Alloy Hatchway Beams Tested at Glengarnock "—of the Institution of Engineers and Shipbuilders of Scotland. The authors are Messrs. M. N. Parker, J. A. Ross and K. V. Taylor.

Behaviour of the light alloy beams was generally similar to that of steel beams of the same scantlings when allowance was made for the differences in Young's modulus; but the elastic strength/weight ratio of the aluminium beam was about 70 per cent greater than that of the steel beam and the ultimate strength/weight ratio over twice as great. With the welding procedure used (reported in detail in the paper) satisfactory welds were obtained between the 0·40 in and 0·85 in thick aluminium plates, and these welds were still sound after the beam as a whole had failed. The tests also suggested that accepted basic design could be improved to make more efficient use of materials.

Driven Piles Cast in Situ

A new name in piling has been introduced into the United Kingdom by H. D. Foundations, one of the Holloway group of companies. Known as the Delta pile, it has been developed by Dicht AG of Switzerland. A steel tube with a loose fitting shoe is first driven into the ground and concrete for the pile is placed as the tube is witndrawn.

The Delta pile is normally of plain unreinforced concrete, though a reinforcing cage is easily inserted should conditions require it. Being a driven pile, the bearing capacity can be calculated according to one or other of the standard piling formulae; concreting takes place in the dry, inside a watertight tube that is withdrawn as concreting proceeds. As in other piles of this type the resulting base of the pile is a bulb of concrete that has been well consolidated by ramming. The piles have a nominal external diameter of 16½ in and the bulb a minimum of 3 ft. Information issued by the company suggests that Delta piles may have lengths up to 75 ft. Batters up to 1 in 4 can be driven.

Headquarters of HD Foundations are at 40 Harleyford Road, London, SE11.

New Buildings at Liverpool University

New buildings for the departments of civil engineering and of physics at Liverpool University have been completed by Holland & Hannen and Cubitts Limited. The buildings are of reinforced concrete throughout, partly in situ and partly precast. While the building was going up electrical strain gauges were placed in various columns, beams and floor slabs. Readings were taken during erection and test loads are to be applied later so that the structure may be fully analysed.

The Physics building has both an anechoic (no echo) room and a reverberation (noise amplification) room. Other rooms include a spectrograph room and an astronomical observatory. In the civil engineering block there are concrete, structures and hydraulics laboratories, each with dust extraction equipment; a photographic suite, photoelastic laboratory and a model analysis room (which will include provision for tidal models). There is also a separate roads laboratory.

On the east side of the civil engineering building there is a memorial panel that is probably the largest of its kind in the world. The precast concrete letters are 3 in thick and were cast into blocks weighing 10 cwt; after erection the panel was faced with brickwork. Consideration of the names on the memorial leads to an interesting speculation of who might be added in the remaining space.

Memorial panel on the civil engineering block at Liverpool University.

Cars for Winter Running

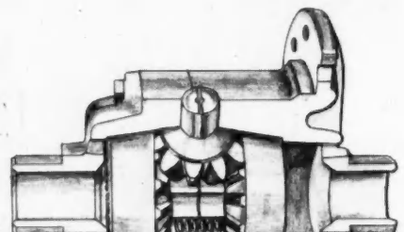
By Gordon Wilkins

Efficient heaters are essential for today's cars, and those with rear engines have special problems. Wheel spin is reduced by limited spin differentials, and spikes will combat ice. Radiator shutters may make a reappearance under Russian influence.

Now that it is exporting half its production, the motor industry has had to change its attitude to heating and ventilation, and efficient fresh air heating and ventilation are incorporated in new cars at the design stage. On the latest Ford Anglia, the original heater installation was scrapped as a result of test runs with prototypes in Scandinavia and a much more powerful system devised. Produced in collaboration with Delaney Gallay, it is a compact unit mounted on the scuttle, drawing fresh air from an intake below the windscreen and providing full-width windscreen demisting and defrosting, still a rarity on a light car.

The same company also makes the heater for the Triumph Herald, which incorporates the American-type Ranco valve which controls the flow of water through the heater matrix thermostatically.

An exception to the current rule is the BMC small car in which the heater-demister system



Borg-Warner spin-resistant differential. It ensures good drawbar pull when one wheel is tending to lose traction.

was not incorporated at the start, purely from lack of time. As one engineer with experience of complex car heater and ventilation systems remarked, "Designing the heater-ventilation system can take as long as designing the car." The Austin Seven and Morris Miniminor will therefore have simple recirculating air heaters until work on a built-in fresh air system can be completed. Pressurised cooling systems in conjunction with thermostats set to maintain higher running temperatures have also contributed to increased heater efficiency.

The most elaborate of recent heating and ventilation systems is that on the Rolls-Royce Silver Cloud II and Bentley S2, with further variations for the Rolls-Royce Phantom V. The heater matrix is stowed inside one of the front wings and is connected to the frontal intakes, the windscreen demister slots and to the car interior by moulded polythene ducts. Two knobs on the instrument panel give control over water flow, air flow, the booster fan and the distribution of air between screen and car interior.

The rear-engined car is difficult to keep warm as the heat normally conducted into the front compartment from the engine and exhaust system is lost and, even on a water-cooled model, long ducts from the rear-mounted heater matrix seem to reduce the efficiency. Cheap and moderately efficient heaters are achieved on air-cooled models by drawing off the cooling air after it has passed over the cylinder heads, but many owners complain that it is accompanied by oily smells. This difficulty was recently made the subject of an attack on the Volkswagen as an "obsolete" vehicle in a leading German magazine.

Well aware of these problems, Chevrolet decided to let the engine heat go to waste and instal a petrol-burning heater in the rear-engine air-cooled Corvair. Such a heater has also been supplied by Porsche for use in very cold climates. Developed by the Harrison Division of General Motors, it uses an electrically driven blower to supply air to a cylindrical stainless steel burner drawing petrol from the engine fuel pump. Ignition is by a spark igniter. The hot gases pass through a heat exchanger which heats fresh air drawn through a scuttle ventilator and fed to the interior by an electric blower. Temperature is controlled automatically by a thermostat which regulates the fuel supply, and a safety switch cuts off the fuel if the temperature rises too high. Normal fuel consumption is about 0·1 gallon per hour rising to a maximum of ¼ gallon per hour. This does not represent a serious addition to running costs at US fuel prices, but at European fuel prices it could involve an additional cost of from fourpence to a shilling an hour to keep the interior of the car warm.

The problem of traction in winter conditions is obviously simplified by the wider adoption of independent rear suspension. Chevrolet recently staged a demonstration of the combined advantages of independent suspension and rear weight concentration by lubricating a test gradient with soapy water: their standard front-engined models were quite unable to re-start, but the Corvair found little difficulty.

Manufacturers of the more powerful American cars are increasingly adopting the limited-slip differential, and the Thornton unit, made in England by Salisbury, is now offered by Aston Martin and Jaguar. It incorporates multi-ring metal clutches as brakes between the sun wheels and the differential cage. A second unit has now been introduced to the British market by Borg Warner. This uses a cone brake between the sun wheels and cage, statically preloaded to provide an internal resistance to differential action within the differential. This ensures an adequate drawbar pull when one wheel is tending to lose traction.

For driving on ice, a good deal of success has been achieved in France with tungsten carbide spikes fitted to the normal tyre casing. They were developed in France and are fairly widely used in French mountain regions where snow and ice are experienced for weeks at a time. Two years ago they were used on the Renault Dauphine which won the Monte Carlo Rally. This led to the introduction of a British version which was supplied to rally competitors by Dunlop to test drivers' reactions. Unfortunately the weather conditions encountered early this year included long stretches of clear road between the ice. The spikes will withstand a considerable amount of use on hard roads, but they became very hot and caused punctures through local damage to the inner tubes; as well as deterioration of the casing.

The possibility of avoiding or at least deferring this type of failure is offered by the revolutionary new BS3 tyre just introduced by Pirelli. The designation—BS3—comes from the Italian Battistrada Separato, meaning that the tyre has a separate tread, and it is in three parts. It consists of a casing without a tread enclosing a conventional inner tube; the tread consists of three separate rings, reinforced with steel wire, which are retained on the casing by air pressure and located laterally by ridges at the side of the casing. When the tread is worn out, the motorist can fit new treads himself by simply deflating the tyre and slipping three new tread rings over the casing. This offers the possibility of keeping a set of special treads giving increased traction for winter use. The cost of new treads is only about 35 per cent of the cost of a new tyre, against about 60 per cent for a conventional retread, and there is not the deterioration of the casing which results from the second curing process in conventional retreading. For driving on ice and snow, the driver can carry with him a set of spikes which can be inserted between the individual tread rings, carrying flat bases which are nipped between treads and carcass as the tyre is reinflated.

The use of a flexible casing in conjunction with treads which are strongly reinforced with steel wire gives a comfortable ride and high cornering power, accompanied by very little noise. The power consumption of the tyre is extremely low; it is claimed that at 85 m.p.h. it absorbs 50 per cent less horsepower than a conventional cover, with a corresponding improvement in fuel consumption.

SHUTTERS OR ANTIFREEZE

Appearance of the Russian cars with manually controlled radiator shutters at Western motor shows may revive interest in this device as a means of conserving engine heat and preventing radiator freezing immediately after starting in very cold weather. Already one accessory manufacturer has introduced a range for fitting to popular cars, spring loaded so that in the event of failure of the control cable, they return to the open position.

Under British conditions, the need for shutters is not very great as it is believed that about 80 per cent of owners now use antifreeze in their radiators. Ethylene glycol is now practically universal, the main sales arguments centering round the various corrosion inhibitors used. Triethanolamine phosphate was widely used, but it initiated attack on copper, followed by organic acid attack on aluminium and iron, so producing graphitisation of the cylinder blocks and impellers.

Other additives are now used, but it seems probable that other cheaper, alternatives to ethylene glycol may appear before long.

New Pirelli tyre with removable treads. Winter treads can be fitted for bad weather, or spiked treads for ice and snow.

Wagon Builders' Anxiety

The recent announcement of the British Transport Commission of their future policy regarding locomotive and rolling stock construction and repair has alarmed the leading companies in the industry. In his annual statement to the stockholders of Gloucester Railway Carriage and Wagon Limited, General Sir William Morgan has outlined the steps which are being taken in the face of the threats to their prospects which the BTC move constitutes. The consequence of the new policy, he points out, will be that railway workshops are kept fully employed and only surplus requirements offered to private industry. This is in fact a situation which prevailed throughout the inter-war period in the locomotive section of the rolling stock building industry and which caused a good deal of controversy when nationalisation of the railways came about.

Sir William told shareholders that the company are intensifying sales efforts in overseas markets, trying to get orders for any and every engineering product which are able to be manufactured in the group, and building up subsidiaries.

In pursuit of this policy negotiations are almost completed for the acquisition for cash of an old established business which will add to the group interests. Further opportunities of this sort may occur, he added, and with this in view it is proposed to increase the company's borrowing powers. This is yet one more example of an industry turning away from its traditional activities. The difficulties of effecting this quickly enough and the many pitfalls in the new paths are well known to industries such as cotton, or aircraft. The recent troubles of North British Locomotive Company are an example of what can happen unless the job of diversification is well executed.

Companies in Aerosol

The first aerosol was introduced in this country in June, 1950, by Cooper, McDougall and Robertson, a company recently acquired by the Wellcome Foundation. It was manufactured after long negotiation between Cooper and United States manufacturers who had developed this type of propellant for insecticides used by American forces during the war. This year 25 million units of various packs are likely to be produced, compared to 16 million in 1958. In the United States the annual production is at the rate of over 500 million. The aerosol industry is one of the fastest growing of British industries.

A small number of pressure valves—a vital component, which must be reliable and cheap—were imported from America by Metal Box in 1950 and Cooper's built the forerunner of their present aerosol filling and packing plant at Berkhamsted. At the same time they formed a subsidiary company called Pafco (Pressure Aerosols Filling Company) to develop aerosols as an industry and to undertake research on new products which could benefit from this type of packaging. Pafco now fills over 60 per cent of all aerosols marketed in Britain today. Most widely used propellants are the ICI Arctons, or mixtures of Arctons. Experiments are being made with nitrous oxide as a propellant for the thicker-consistency products like cream and toothpaste. Du Pont are also prominent suppliers in this country as well as in the United States.

The main products packaged in aerosol so far fall into these groups: the fine sprays, such as insecticides, air fresheners, germ killing mixtures. The mixture is thoroughly emulsified and remains suspended in the atmosphere for a considerable period. The second group consists of coarse sprays for surface coatings and includes moth-proofers, furniture polish, garden sprays, lacquers and certain cosmetic preparations (hair-setting lacquers and sprays). The third dispenses a foam and is used for shaving creams, shampoos. The current forecast, based on market research, is that annual sales in Britain will reach 100 million units within seven years.

Bids and Mergers

Terms have now been agreed for a proposed merger between Metal Closures and John Dale, the makers of collapsible tubes and containers. The proposal by Metal Closures involves the exchange of seven of their ordinary shares for six John Dale ordinary shares and a corresponding number of Metal Closures ordinary for John Dale's loan stock. This offer is much better than that submitted by Winterbottom Industries and a majority of John Dale shareholders are expected to accept it. Substantial economies are expected to arise from the pooling of the two companies' resources as well as greater trading strength.

The recent announcement of the integration of the Reichdrill Manufacturing Company Limited, with the Consolidated Pneumatic Tool Company Limited, has been followed by further details of the reorganisation involved. Robert C. Paul, managing director of the Reichdrill Manufacturing Company Limited, will now head the Reichdrill Division of the Consolidated Pneumatic Tool Company Limited, and operate in cooperation with their contracting department from the Company's head office in London. All manufacturing operations and spares will be transferred to the Consolidated Pneumatic Company's works at Aberdeen. The Reichdrill Manufacturing Company's head office and works at Wishaw, Scotland, and sales office at Clarges Street, London, have ceased to operate.

Shipyard Alarm

Recent reports that a contract had been signed between Verolme United Shipyards and American European Lines N.V. for the construction of the first of two giant passenger liners must have excited many in British shipbuilding circles.

For the British reply to this challenge the next step should be the report, eagerly awaited, of the Three Wise Men considering the replacement of the Queens.

The idea of 100,000 ton, 8,000 passenger liners for cheap fast Atlantic travel has been canvassed for some time and it is one of its advocates, Mr. Edgar L. Detwiler who is backing it with a firm order. The shipbuilder, Mr. Cornelis Verolme, is described as a dynamic personality, an agressive opportunist who has built in very quick time a vast shipbuilding empire embracing yards in Holland, Norway and projected yards in South America and Ireland. It is in Mr. Verolme's new and most modern shipyard in Rotterdam that the giant liners will be built.

Meanwhile virtually no new orders are being obtained by British shipbuilders and the industry is steadily working off its back-log of work. From a peak of 5 million tons in mid-1957 orders in hand have fallen steadily—a fall assisted by some cancellations—to its present level of 514 ships aggregating 4·47 million tons. This still represents two to three years' work, worth some £660 million, but business is not evenly spread and a number of small and medium sized yards have almost reached the end of their order book. This trend is made worse by the tendency of owners to postpone the building of the tonnage they have on order until there is a recovery in freight rates. Shipbuilding Conference statistics show that only 146,000 tons of orders have been booked during the first nine months of this year, representing little more than one month's work for the industry.

There are so far no signs of a revival of demand in the home market. The only hopeful indications of renewed ordering come from foreign yards. Yet many British users must soon face the problems of re-equipping, for they will have to fight hard for profitable freight, or for passenger business, and can only do so if they are properly equipped. Mr. Detwiler's order on Mr. Verolme suggests that aircraft cannot do what ships can do. This is the kind of aggressive outlook which could revive the British shipbuilding, and shipping, industries.

Power Gas Reorganisation

A new organisation structure has been set up for the conduct of the trading activities of the Power Gas Corporation Limited. As from this month two wholly owned subsidiaries, Ashmore, Benson, Pease and Company Limited and P.G. Engineering Limited, will operate independently, each in its own specialised field. The link between them is provided by the common chairman, Mr. W. R. Brown, and the common vice-chairman, Mr. C. E. Wrangham.

Ashmore, Benson and Pease will control the company's Stockton works, manufacturing and selling all types of heavy engineering products, and specialising in the design and supply of plant and equipment for the iron and steel industry. P.G. Engineering will undertake the design and supply of plant and equipment to the chemical, gas and petroleum industries, and also engineering contracts of a general character. This new arrangement, which is tantamount to a divisionalisation of activities on a product basis, follows the current trend in the British engineering industry among some of the larger concerns.

Records in Shipbuilding

National Bulk Carriers, of New York, United States of America, appear to have a considerable appetite for making world records in the former Japanese Navy shipyard at Kure, which they now run.

A standard tanker of 46,000 tons was completed there in the remarkably short time of four months. The 108,000 ton super-tanker Universe Apollo was built there last year in a little over six months. These are some of the figures behind the speed with which Japan has advanced in the lists of world tonnage.

At Kure there are two adjoining shipyards approached from Hiroshima from the west through tunnels in the mountain side. The first is the Kure shipyard of National Bulk Carriers, the second is operated by a Japanese company. Both before and during the war these yards were operated as a single unit by the Imperial Japanese Navy. Here they built the Yamamoto, the largest warship in the world, and many of the big aircraft carriers.

Since the town may be approached through the two tunnels it was able to be sealed off completely, with its inhabitants. The Yamamoto was in fact built behind camouflage screens so that, at any rate to seaward, it was not possible for Occidental eyes to observe what was going on. Since the largest of the construction berths was the floor of a dry dock, there was no launching problem. Once the hull was in a suitably advanced state it was only necessary to flood up. This dock is so large that more than one vessel may be built at a time. A new 30,000 ton dredger, another world record in size, is being built for Maracaibo, in Venezuela.

Of obvious significance to our home shipping and oil industries is the speed with which the Kure yard, in this same berth, is preparing for the next tanker, which will be of 118,000 tons. It is in this berth also that the Kure yard is able to boast that 350 tons can be raised in a single lift.

Ministry Laboratory Directs Inspection

Examining equipment for the Ministry of Defence is the daily task of members of the Inspection Service. One of them may visit your firm regularly. Behind him is a laboratory that guides his work.

The supply of equipment to many Government departments is greatly helped by the smooth running of the Ministry of Defence Inspection Service. How the service does this was shown during recent open days held by the Electrical Inspection Directorate. Exhibits showed a range of work far exceeding that associated with passive inspection. Research plays an important part. Modern equipment is usually capable of high precision, for it often has to work in severe environments. Because of this, inspection standards and methods cannot stand still and they have to be improved all the time. The Inspectorate has to keep itself at the forefront of developments.

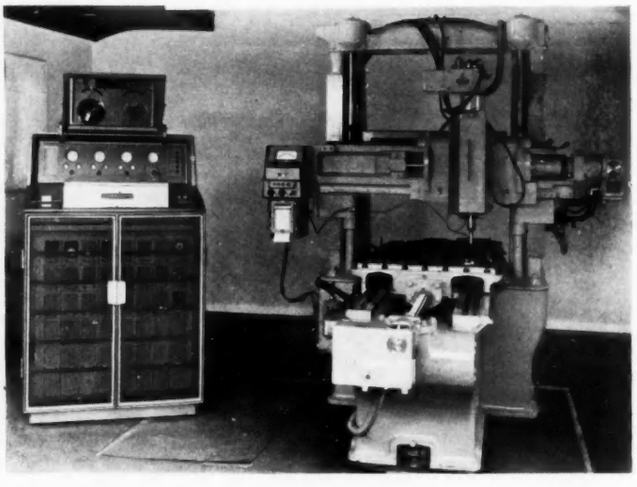
The EID, three other engineering inspectorates, and the Chemical Inspectorate make up the Ministry of Defence Inspection Service. Responsibilities are functionally divided: each directorate is concerned with a particular range of techniques. Inspection of all electrical (including electronic) equipment and instruments supplied by the Ministry falls to the EID.

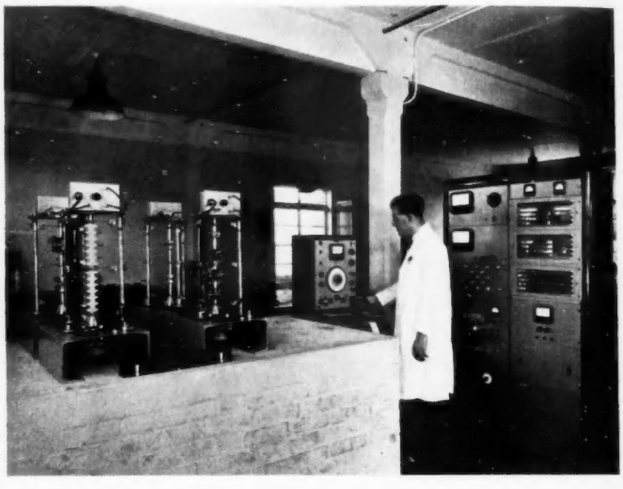
Inspection during manufacture is carried out or supervised by a country-wide regional organisation, technically directed from EID headquarters. These are situated at "Aquila," Bickley, Kent. (Derivation of the name comes from the Inspectorate's motto: "Aquilae Oculo"—"with an eagle eye.") The laboratories and workshops there have been largely developed to support the inspection staff in the regions. This support may either be direct: for example, providing a service for independent testing of equipment, components, or materials; or it may be indirect: by thoroughly testing prototypes to produce a rigorous specification for newly developed equipment.

In fact, EID sees its functions as of broadly two categories, technical direction and executive inspection. The first is associated with post-design control and pre-contract work. It is carried out by specialist officers, each responsible for a specific technique. The officers also prepare technical instructions and give technical guidance to regional staff. It is the regional staff who carry out executive inspection.

Post-design control mainly applies to Army equipment. It entails full technical control of equipment after it has been passed for production. Reports of defects from the user are investigated and draft modifications are drawn up as needs be. User reports of defects in all RAF equipment are also investigated by EID; but in this case they do not produce modification instructions. For War Office equipment also EID sees that full manufacturing and other specifications for tenders and contracts are available.

Executive inspection of equipment during production is the responsibility of EID staff located in the regions. Again two methods are used: direct and approved. The latter applies when the Director General of Inspection considers that the firm dealing with the Ministry of Defence (or likely to deal with them) has an adequate inspection organisation of its own. If this is so, approval is formally given. And where the products of the firm are appropriate, EID is responsible for supervising the firm's organisation.





Accurate measurement of complex shapes is carried out by this tape-controlled machine shown in the left hand photograph. Deviations from specification are recorded on a chart. The photograph on the right shows equipment for testing electronic valves for vibration noise and fatigue.

ENGINEERING SERVICES

At Aquila the Inspectorate has three main technical divisions: power and instruments; electronics; and engineering services. Each of the three is further divided into a number of branches.

Included in the engineering services division are the electronic services branch, the metallurgical branch, the packaging branch, and the technical services branch. The last provides a service to the whole inspectorate in the fields of metrology, design and manufacture of inspection equipment, drawing and printing. Its metrology section is equipped with a wide range of measuring instruments controlled to NPL standards of accuracy by certified "standard references." Within the section, staff design, provide, and inspect gauges and measuring instruments used by the inspectorate; they also make critical dimensional measurements of detailed parts, as required.

The metrology section is investigating automatic measuring techniques. The machine shown in the left-hand illustration, for example, has been undergoing tests at Aquila for the past year. It is a three-dimensional tape-controlled milling machine in which the cutting head has been replaced by a universal measuring head. The head, under tape control, is made to track around the ideal shape of a component; wherever the actual shape of the component deviates from this the error movement of the head is registered on a moving chart.

The measuring capacity of the inspection machine is 30 in by 20 in by 7 in. Accuracies better than 0·001 in are being obtained on dimensions up to 18 in. The machine is basically the framework of a jig-boring machine. The slideways table and cross-slide have been reworked and converted to run on air bearings. To eliminate backlash, lead screws have been replaced by recirculating ball nuts and lead screws of special design. In addition, the normal borer-quill bearing housing carried on the cross-slide has been replaced by a new design, which gives controlled vertical movement to the measuring head. Standard Ferranti machine tool control equipment, including servo motors and gear boxes, are fitted to all three lead screws—in the three mutually perpendicular axes—together with diffraction grating units, which provide the feedback for this closed-loop system. The control cabinet, incorporating the tape deck unit, is shown to the left of the main machine. Development is continuing to investigate the versatility of the system and to improve accuracy.

The measuring head with a standard proprietary indicator and recorder is a self-contained measuring system. It has many applications apart from this machine. Laboratory tests show accuracies in the order of $\pm 0{\cdot}00005$ in over the $\pm 0{\cdot}005$ in range. The range can be varied between $\pm 0{\cdot}0005$ and $\pm 0{\cdot}015$.

PACKAGING BRANCH

Somewhat simpler, but none the less effective equipment was shown by the packaging branch. When testing packages for resistance to shock loading, it is essential to record the forces involved. There are various ways of doing this, but generally speaking they involve expensive equipment, such as an oscilloscope and associated power equipment. The packaging branch has designed and arranged for the limited production of the lead pellet impactometer, which is a simple and cheap alternative. It is a compact unit weighing 2½ oz. A steel plunger rests on a lead pellet—applied shock causes indentation of the pellet. As the size of the indentation varies directly as the size of the shock, the diameter of the impression is a measure of the forces involved, the force in terms of acceleration g being read from a graph.

The metallurgical branch of the engineering services division serves the headquarters and regions and is concerned with the quality and suitability of metallic materials, fabrication processes, and finishes. It provides a consultative service on day-to-day metallurgical matters arising from inspection, and also investigates fabrication troubles and failures. One of its exhibits showed how satisfactory simple methods could be. This particular technique was concerned with the tensile testing of very fine wire, with a breaking strength of a few ounces. The wire is suspended vertically, with a polyethylene bag attached to its end; water is run from a burette into the bag until the wire breaks. The breaking load can be calculated direct from the burette reading, or the bag and its contents can be weighed.

POWER AND INSTRUMENTS

Within the power and instrument division are branches concerned with the computers, electrical work, optics and power. Tests in the electrical branch laboratory are designed to ensure that equipment supplies to the Services is safe, reliable, and efficient. One of the instruments developed there tests the balance of electrical instruments, the defective balance in an indicating instrument being shown by the departure of the pointer from zero when the instrument is tilted or inclined in any plane. It is specified as the displacement from zero, expressed as a percentage of scale length.

The instrument balance tester was designed by the branch because there was previously no means of measuring such defects without dismantling the instrument. The instrument to be tested is securely clamped behind a cover plate that carries a scale graduated in degrees. A graduated arm, pivoted at the centre of the scale and fitted with an eyepiece, is provided to sweep this scale as desired. Adjustment of the whole of the cover plate assembly enables the axis of the instrument movement to be aligned with the pivot of the moving arm. The scale length of the instrument cab can then be quickly calculated from measurements made with the graduated arm. By tilting the cover plate assembly any zero displacement can be measured.

These of course are only a few of the development projects in the EID. They help to show the diversity of work carried out in laboratories responsible for the inspection of a most diverse range of equipment. Equipment that includes domestic irons and diesel generators, kinetheodolites for ballistic missile ranges and packing cases for everything.

ELECTRONICS DIVISION

The electronics division includes branches for atomic weapons, radar, signals and electronic components. All the work undertaken by the atomic weapons branch is directed to ensuring that the electrical sections of atomic weapons have been manufactured correctly and will be satisfactory for Service or trials use. No fault, not even of a minor nature, can be tolerated. Because of the nature and high cost of a nuclear device, reliability of these stores has a special significance. Special attention is given to the development of inspection techniques to enable units to be tested under particular environmental conditions such as extreme temperature, high altitude, shock and vibration. One contract is to produce X-ray stroboscopic equipment that will give a slow motion picture of component resonances occurring inside a sealed container during vibration.

No electronic equipment can be better than its worst component. It is the responsibility of the electronic components branch to provide technical direction and support for the inspection of a very wide range of " common use " items. Equipment for making vibration noise, fatigue, and resonance search tests on the " reliable " series of electronic valves is shown in the second illustration.

On the left of the second photograph are the vibration heads in which the valves under test are mounted. The units are supported on an isolated concrete plinth to minimise vibration transmission to the surroundings and vice-versa.

DIFFERENT HEADS AVAILABLE

Various types of head are available; they can accommodate a wide range of valves in three planes of orientation. From 8 to 24 valves, according to type are held in each head; barium titanate crystal accelerometers are fitted. The outputs from the latter are fed via matching units to a control amplifier, which indicates the output voltage proportional to the acceleration on a panel meter. The amplifier also provides a control voltage for regulating a compressor circuit in a beat frequency oscillator. Output from the oscillator is amplified by a unit capable of delivering 1 kW maximum power, this being used to drive the moving coils in the vibrator heads. Oscillator frequency control is varied over the range 20 to 2,500 c.p.s. by a motor which also drives a recording chart. On the latter, the output noise from the valve under test is logged. It is thus possible to arrange for a constant acceleration to be applied over the frequency range when performing resonance search tests.

The electronic components branch also test components to determine their ability to carry out their normal functions while under conditions of climatic stress. Humidity and temperature chambers produce climatic conditions in strict cyclic sequence, and can be set to simulate day and night conditions. Each chamber has a weekly recorder. A refrigeration and vacuum unit are used to simulate stratospheric conditions.

IMAGE INTENSIFIER WITH HIGH DEFINITION

An instrument capable of detecting very low intensities of light has been developed in the department of instrument technology, Imperial College, London. It gives an image 50,000 times brighter than the original object. It is so sensitive that it is being adapted to track the passage of an atomic particle through matter by detecting the photons it throws off. Other applications are found in astronomy and radiography.

The image intensifier, as it is called, is not a new idea. The achievement of the Imperial College team—Dr. W. L. Wilcock and Mr. D. L. Emberson—in this particular instrument has been to develop a method of construction that gives a high gain in brightness without loss of definition. They brought this about by refinement of thin-film techniques.

The image intensifier, shown in the illustration, is a glass vacuum tube some 18 in long and 2 in in diameter. At one end is a cathode, a thin layer of semi-conducting material produced by evaporating caesium onto antimony. When light from the object under scrutiny falls on the sensitive layer, it ejects electrons. These are then drawn through a series of positively charged electrodes in which electron multiplication takes place. By the time the end of the tube is reached some 3,000 electrons are streaming out for every single electron produced at the cathode. The stream of electrons falling on to a fluorescent screen produces a bright visible image.

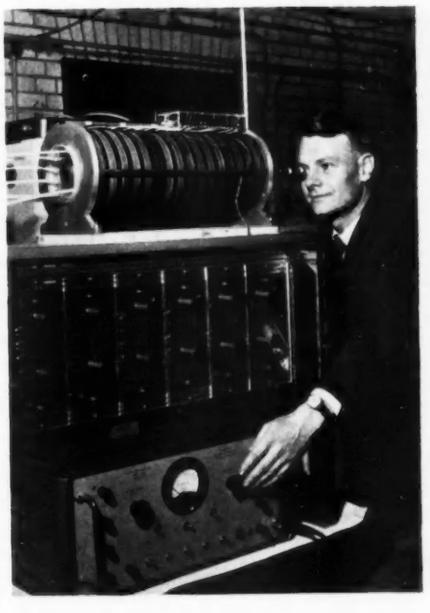
Such electron multiplication is widely used in nuclear instrumentation. The particular feature of the new instrument is that the pattern of electrons ejected at the cathode as a result of a pattern of light is maintained throughout the tube as the number of electrons multiplies. The actual definition of the picture obtained is equivalent to a television system using 250-line scanning. It is considered that with a larger diameter tube—the present one is only 2 in across—higher definitions equivalent to 6-700 line television could be obtained. The coils seen around the tube provide a magnetic field which helps stabilise the image.

Electron multiplication is obtained in thin plates called dynodes. They are actually layers of thin films and it is their construction that provides the key to the successful operation of the equipment. They are formed by depositing potassium chloride on to a thin film of aluminium. As the aluminium has a thin layer of oxide on its other side, a sandwich structure is formed. The total thickness is a few hundred atom diameters. The central aluminium film in particular calls for careful production. It is transparent and is formed by etching aluminium which has already had an oxide film formed on one side of it.

Two lines of improvement of the instrument are envisaged. The cathode efficiency should be increased so that a smaller number of photons are needed to eject an electron; at present only about 1 in 20 incident photons results in the ejection of an electron. Also the dynode films, which are circular and about ½ in diameter, will probably be increased in area. These two improvements would lead to a further increase in brightness and definition.

With no light incident on the cathode, flashes can be seen on the viewing screen. These are caused by the spontaneous emission of electrons from the cathode. Low temperature experiments will be carried out to see if the effect is much reduced by cooling.

The value of the instrument in astronomy is that it enables much shorter exposure times to be used for the photography of stars and planets. The reduction of blurring by atmospheric turbulence, resulting from the shorter exposure, is likely to be of great value. For example, all the illustrations of the surface details of Mars are hand sketches: photographs do not have adequate definition after exposure for the length of time normally required.



The device not only increases light intensity by 50,000 times, but also retains the definition of the image to a greater degree than ever before.

MATCHING POSITIVE DISPLACEMENT SUPERCHARGERS TO FOUR STROKE DIESELS

By Talaat E. A. Youssef, Ph.D., M.Sc.

Lecturer, Faculty of Engineering, Cairo University

Of the positive displacement superchargers, the Root's and Lysholm blowers are almost the only types now used for supercharging internal combustion engines. The Lysholm blower has an advantage over the Root's blower owing to its higher adiabatic efficiency, especially when the delivery pressure changes are limited to a narrow range.

Gear-driven superchargers operate at a fixed speed in relation to the engine crankshaft, so that, if they are of the centrifugal type, their delivery pressure will be proportional to the square of the engine speed and the maximum mean effective pressure will be available only at the maximum engine speed. Superchargers of the positive displacement type, however, normally deliver an approximately constant quantity of air for each engine stroke, which means that a high mean effective pressure can be developed at any engine speed. Such an advantage is not fully achieved in practice owing to leakage in the blower and variations in the engine volumetric efficiency; both being dependent on engine speed and induction manifold pressure. The blower, therefore, has to be matched to the engine, otherwise an appreciable fall in manifold pressure would result at reduced engine speeds, and thus, the main advantage of this type of supercharger would not be realised.

Before carrying out experimental tests on engine-blower combinations to check their proper matching, an analytical investigation should be undertaken first; not only to save an appreciable amount of time and expense, but also to facilitate the prediction of the modifications that are likely to be needed in the blower to change its characteristics, with a view to effecting a better matching of the engine requirements.

At any speed, the volume of air delivered by the blower must equal exactly the volume of air consumed by the engine, otherwise the blower delivery pressure and, correspondingly, the engine induction manifold pressure, would rise or fall until this condition was satisfied. Fig. 1 shows the air demand of a diesel engine of 970 cu. in swept volume at different engine speeds and induction manifold pressures. If it is desired to supercharge this engine to a boost pressure of from 11 to 12 lb per sq. in, the proper size of blower would have to supply about 420 cu. ft of air per minute at that pressure. Curves in Fig. 1 showing the volume of air delivered by the selected Lysholm blower at different pressure ratios throughout the engine operating speed range are plotted on the same coordinates. Variations in the volumetric efficiencies of both the engine and the blower were taken into account in computing the values of Fig. 1. The intersection of the engine air demand curve for any particular manifold pressure with the blower delivery curve at the same pressure indicates the engine speed at which this pressure is likely to be attained in the inlet manifold.

As seen from Fig. 1, the matching of the blower delivery to the engine air demand takes place at a gradually decreasing manifold pressure as the engine speed is reduced. Between 1,650 r.p.m. and 700 r.p.m. the blower delivery pressure decreases from 26·5 to 22·8 lb per sq. in absolute.

Comparisons between the brake horsepower, torque, brake mean effective pressure and specific fuel consumption curves for supercharged and normally aspirated engines may be made on the basis of Fig. 2. It will be noted that the engine b.h.p. has increased from 179 to 282 at 1,650 r.p.m. and from 98 to 137 at 800 r.p.m., i.e., a b.h.p. increase of 57 per cent at 1,650 r.p.m. and of 40 per cent at 800 r.p.m. The specific fuel consumption, however, has been increased from the minimum value of 0·369 lb per b.h.p.-hr for the normally aspirated engine to the minimum value of 0·3845 lb per b.h.p.-hr for the supercharged engine, i.e., an increase of about 4·3 per cent. The increase in fuel consumption is due to the rather considerable power absorbed by the blower. This is contrary to what is experienced with turbo-supercharged engines which generally have better thermal efficiency and lower specific fuel consumption than when running normally aspirated. The power to drive the turbo-supercharger is secured from the energy in the exhaust gases and except for the slightly higher pressure in the engine exhaust manifold, the turbocharger does not impose any load on the engine.

All the same, the turbo-supercharger does not yield the approximately constant manifold pressure generally achieved by the positive displacement blower. Thus, in applications where the applied load would demand high engine output at maximum as well as at minimum engine speeds, the positive displacement blower may be preferred to the turbo-supercharger, in spite of the probable slight increase in fuel consumption.

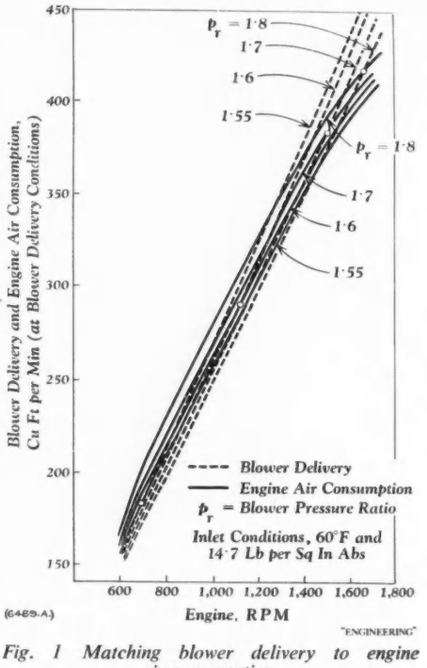


Fig. 1 Matching blower delivery to engine air consumption.

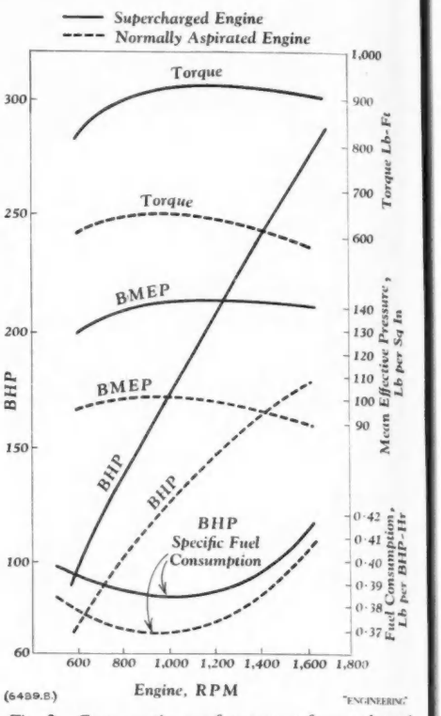


Fig. 2 Comparative performance of supercharged and normally aspirated diesel engines.

Photocopies of the complete paper, on which this digest is based may be obtained from the Publisher, ENGINEERING, *36 Bedford Street, London, WC2, price 10s ($1·50 to the United States and Canada), post free. Remittances should accompany the order.*

MEASURING LOW ACTIVITY

To measure low levels of radioactivity in a sample it is important to reduce the background acvitity registered by the counter tube. Shielding with radiation-free materials brings about some reduction but very often, when for example it is necessary to measure low levels of trontium 90 beta-activity, much of the background is produced by mesons of cosmic radiation. Shielding against such high energy particles is generally impracticable and a guard ring of counters is used—counts from the central tube being ignored if one of the guard tubes has also fired. Such an assembly is, however, itself costly to shield and a more easily shielded system has been developed at the Synchro-cyclotron laboratory of Philips Limited, Amsterdam. To suit geometry, the two electrodes of the single guard counter employed are cylinders with concentric hemispherical ends; within these is the beta counter.

BURNUP AND FLUX INSTRUMENTATION

The activation wire drive instrumentation system developed by Teleflex Incorporated, North Wales, Pennsylvania, USA, is used to ascertain neutron flux and fuel distribution information from a reactor core. The main function of this equipment is to obtain test data related to the performance of a reactor and provide a basis for calculation of fuel burnup history. The device (1) measures steady-state thermal neutron flux distribution throughout the reactor core; (2) measures full distribution among specified core locations during operation; and (3) provides continuous indications of instantaneous thermal neutron flux values at selected points within the core. By use of Teleflex flexible cable, both activation wires and neutron sensitive thermocouples may be inserted into the reactor core remotely.

On the Shelf

By Frank H. Smith

A large bibliography (No. 5, part IX) comes from DSIR's Fire Research Station, Boreham Wood (there seems to be some indecision as to whether that is one or two words). Called *References to Scientific Literature on Fire*, it looks like a title devised by somebody with a sense of humour or with no humour at all. It is an " unpublished " document which might mean that if you want a copy you'll get one for the asking if you're lucky.

An interesting little booklet is available from the Fire Protection Association, 31-45 Gresham Street, London, EC2. It gives particulars of the aims and purposes of the FPA, including a library and information service. For a subscription of a guinea a year it strikes me as being well worthwhile considering as an additional insurance.

The same people are organising a thumping great conference (on fire protection, of course) at £2 10*s* a nob (members less 10*s*) in February, 1960. Apart from old jokes about visiting firemen this should be worth attending—and there is a dinner to follow at £1 7*s* 6*d* (exclusive of wines and firewater). This is a fine opportunity to learn something and, at the same time, test that expenses account gag.

Interscience Publishers seem to be running up the numbers as, for instance, " Advances in Enzymology " at Volume 21 and " The Chemistry of Heterocyclic Compounds " up to Volume XIII. As a matter of interest (as most of my stuff is), the leaflet advertising the first (that is, the twenty-first) is also a cumulative subject index of Volume 1 through Volume 20. Did you see that hooha in the Press about the Old Vic using " thru " (instead of up to and including) to describe the final date of one of their programmes? Even *Punch* had a go. It reminds me of the North Country habit of using " while " instead of " until "—i.e., Friday while Monday for a weekend or " I never drink while I'm thirsty."

It is numbered 1 and dated July, 1959, but whether it is one of 1959 or one of all time I don't know. It's the " Catalog of Microcard Publications " (West Salem, Wisconsin) and has things like the *Trans.A.S.M.E.* Vols. 55-78 at $200. When you come to think of the space taken up by that lot you'll begin to realise the value of microcard—if you can persuade your readers to do a form of TV watching in your library.

From the catalogue of Phoenix House (Aldine House, Bedford Street, London, WC2) I cull the following for fond and/or harrassed parents: *The Cherry Tree*, a selection of nearly 600 familiar and unfamiliar poems for young people (Geoffrey Grigson) and *The Children's Book of Make and Do*, by Gert Lindner; 25*s* the first and 18*s* the second. I make no apology for these mentions. The evenings are dark and Christmas approacheth.

For your owt for nowt file. The British Electrical Development Association of 2 Savoy Hill, London, WC2 (you're too young to remember when Savoy Hill was synonymous with 2LO, my son) offers a free film loan service. The latest addition is " Industrial Electric Heating " (and I write this on a day when we have been told that power and light will cost much the same for some time to come) and, as is to be expected, deals with electrical process heating of all kinds in most industries. This is what is known as blanket coverage—electric blanket in this case. Just the thing to warm up an audience in a village hall and it lasts for 30 minutes. Other films deal with handling, lighting, isotopes (how doth the little isotope proceed at such a steady lope), motors and lots more. By the way, these films are suitable, in some cases, for schools.

MAN SEES FURTHER IN THE NIGHT

The Individual and the Universe. By A. C. B. Lovell. The BBC Reith Lectures, 1958. *Oxford University Press.* (10*s* 6*d*)

On 15 November a new series of Reith Lectures are to begin in the BBC's Home Service. They will be entitled " The Future of Man " and will be delivered by Professor P. B. Medawar, F.R.S. The time is not inappropriate therefore to recall the last series, by Professor Lovell, and perhaps to link the two; the universe is after all the context of human destiny.

This book consists of the six Reith Lectures broadcast during the autumn of 1958. Apart from a few added footnotes here and there, no attempt has been made to amend them, so that they are printed exactly as they were delivered. This policy is wise, and the overall impression is of a masterly little book—full of information, and yet so clearly written that it may be understood throughout even by the scientific beginner.

The first chapter, " astronomy breaks free," is essentially historical. Next comes " the origin of the solar system," and in the third chapter we reach " the new astronomy," in which modern radio methods are discussed. It is brought home to the reader that radio astronomy, which began with Jansky's almost accidental discovery of radio waves from space less than thirty years ago, has caused what is tantamount to a revolution in astronomical techniques; the 20 pages in this chapter give a clear picture of the investigations now in progress.

Chapter four, " astronomy and the State," is intentionally controversial. Lovell considers that the Western Powers are not making the best use of their scientific potential, and it is difficult to quarrel with him; it is to be hoped that his words will be read by those responsible for the present official policies.

The two final lectures deal with the origin of the universe, and here again the importance of radio methods is evident. However, the author is careful to avoid any suggestion that radio astronomy will eventually supersede optical methods, and his speculations as to future research are cautious and logical.

Altogether, the book is an unqualified success. The print and presentation are of a high standard, and misprints virtually absent. There are no illustrations, but in a work of this sort illustrations are an unnecessary luxury; so that the price is not unreasonable by modern standards. Lovell has much to say, but perhaps the most significant sentence in the whole book comes at the end of chapter four: " The fate of human civilisation will depend on whether the rockets of the future carry the astronomer's telescope or the hydrogen bomb."

Patrick Moore

MAN SEES MORE FROM TEN MILES HIGH

Ten Miles High Two Miles Deep. By Alan Honour. *Brockhampton Press Limited, Market Place, Leicester.* (12*s* 6*d*)

The title *Ten Miles High Two Miles Deep* refers to Professor Auguste Piccard's ascent in a stratospheric balloon and his descent in a bathyscaphe to the ocean bed. Mr. Honour's book is a short study intended for children of the life and work of Professor Piccard, of his twin brother Jean Felix and of their colleagues. Most of the book understandably deals with the achievements of Auguste, but we are told also of the contribution which Jean Felix and his wife made in the United States to the designing of balloons. (It was Jean Felix, for example, who developed the use of electrically detonated charges of TNT in the release mechanism.) Among the book's exciting moments the finest is the description of Auguste's first ascent.

What could have been simpler than Auguste's temperature control device? Half the spherical gondola was painted white and the other half black, and by means of a revolving mechanism it could be turned so that the sun's rays would be either reflected or absorbed. And what could be more terrifying than to find ten miles above the earth that the revolving mechanism would not function, and that Auguste and his assistant were liable to be roasted alive? One of the healthiest features of the book is the way great scientific achievements are shown to be the result of quite simple principles, which have been put into practice through ingenuity, patience and hard work. Another is the emphasis placed upon the contributions which the twins and their colleagues have made to scientific knowledge and the good of mankind. The balloons, among other things, have made possible the direct study of cosmic radiation in the stratosphere; the bathyscaphe has made accessible new worlds of marine life and geology.

To an adult reader the book is disconcertingly disjointed; but this is not a serious fault when it enables the author to digress on a wide variety of topics, including cloud chambers, the Montgolfier brothers' experiments with hot-air balloons, and the myth of the Pleiades. In some of the more literary passages Mr. Honour's style is a little pompous, like an over-zealous translation from the French; but he is always clear, and his estimate of his young reader's intelligence is generous. *Ten Miles High Two Miles Deep* should prove an admirable stimulus to the imagination of a child who has reached the age of scientific curiosity.

C. J. Albu

MAN SEES MOST IN HIS OWN BACK YARD

To Feed the Hungry. By Danilo Dolci, translated from the Italian by P. D. Cummins. *MacGibbon and Kee.* (30*s*)

Very few of Signor Dolci's admirers the world over know that their hero is an engineer and an architect—a qualification that Mr. Aldous Huxley takes pains to underline in his preface. Mr. Huxley goes on to add that " surrounding this central core of specialised knowledge there is an aura of general scientific culture." The ideal reader of this book would be a Dolci-minded engineer, that is a professional man with an overwhelming sense of charity and love for mankind even if not quite disposed to devote his life to the solution of such formidable social and economic problems as Dolci himself has tackled. But the sad conditions exposed and documented in this wholly humane book are in fact an appeal to the engineers of most specialities, civil, mining, chemical, oil, mechanical, agricultural and so on, to suggest how the potential wealth latent in the rich soil of Sicily may be extracted.

How do the people of Palermo live? What are the conditions of existence in the surrounding countryside, which forms a large province of 81 communes? To answer these questions, Dolci has collected many hundred " autobiographies " from inhabitants of the slums and the incredibly squalid villages of this region, portraying the unemployed and the landless, so building up a heart-rending picture of human misery and destitution.

But this " Franciscan with a degree," by interrogating more than five hundred labourers, evokes an implicit appeal to the civil engineer,

Continued on next page

who can best help in tapping underground water supplies (50 per cent of the irrigated land in Sicily is already watered from subterranean sources). One of the main practical results of Dolci's non-violent campaign has been to exact from the authorities the construction of a dam on a torrent running through the most desolate part of the Palermo province—on the other side of the watershed where the "Conca d'oro" lies, the smiling "Golden Bowl," crowded with orange groves and orchards.

The phenomena of abject want and the physical and moral degradation of individuals and groups have gradually become exceptional in a Europe where once they were the rule. This historical development, presented to readers in books which appeal to their emotions rather than to their reason, is in the case of Dolci and Sicily a case for optimism. Sicily is today part of a modern State, largley industrialised, rich in productive and organising capacity. In the post-war reconstruction of Italy, the Government has taken as one of its first objects the question of industrial and agricultural development, especially in the southern provinces, including Sicily.

The island forms the largest area where economic progress has been retarded; in Sicily these conditions are most apparent, with its large population (about 10 per cent of the total population of Italy). It is, however, rich in agricultural and industrial resources, such as citrus fruits, sulphur and salt, natural gas and potash. Its tourist traffic at Taormina, Syracuse and Palermo is of great importance and continues almost the whole year round. Its fisheries are among the most prosperous in the Mediterranean.

To Feed the Hungry is an unassailable principle. But unlike the homeless refugees, characteristic of a post-war Europe, the Sicilians are deeply attached to the countryside and urban centres they live in, and they can easily assimilate the skilled trades and industrial techniques which would enable them to compete in world markets. Manna once fell on the Jews in the wilderness, and petroleum and natural gas discovered beneath the ground could easily take it place in the Sicily of modern times. Dolci can well present the case for improved social organisation and better facilities for education, which will open the way to more efficient use of manpower. Yet there is a risk that the charitable intervention of sympathisers, moved by the suffering of the people might defeat its own object by adding to the already existing sense of helplessness and frustration, or by exciting dangerous opposition inspired by a deep-rooted background of pride.

Let us see instead what comes from practical assistance. During recent years the *Cassa per il Mezzogiorno* (Southern Fund) has provided millions of pounds for agriculture and for setting up new industries. This organisation has been created by the Government to finance economic development through special non-profit making institutions. The World Bank has contributed $300 million in loans (more will be forthcoming) while Government grants and investments are pouring in regularly through appropriate corporations financed by the *Cassa per il Mezzogiorno* and mostly supervised by the Bank of Sicily.

Unemployment is still high, but the patches of squalor and proverty are not expanding and are being gradually attacked on all sides by land reclamation, land reform and public works. It is above all by the use of local resources on a strictly economic basis that the rhythm of social rehabilitation can be increased. Petroleum and natural gas have created and are creating centres of modern industrialisation along the south coast of Sicily: especially at Ragusa, Augusta and Gela. Prospecting for oil is going on in hundreds of concessions covering several thousand square miles all over Sicily. In the last three years two chemical factories have been built and have started production in southern Sicily. Oil is already being pumped out to the tune of more than a million tons a year, and this amount will be doubled and trebled in the early sixties. Refineries have sprung up near the excellent harbours on the south-east of the island which are fed mostly by Middle-East oil for Italian requirements and for export to several Mediterranean countries.

Mechanical engineers are at work. Palermo harbour, enlarged with the capital and technical resources of a private shipbuilding firm from Genoa, includes the largest dry-dock in the Mediterranean. It regularly employs about 3,000 workers to whom was added considerable casual labour when tankers started calling on their way to the Middle East. In contrast to this success of private enterprise, the experiment of a highly subsidised textile mill does not seem able to meet the competition of the products of northern Italy.

Electricity consumption is sluggish owing to the low standard of living, but the rate of increase is much greater than in the rest of Italy, and consumption was more than doubled in the last seven years. A programme for trebling the Sicilian power generating capacity has been planned so as to meet the demand which is likely to follow from economic development. An important contribution is the progress already achieved through the discovery of fairly large potash salt deposits. Other factors are the rapid growth of oil mining and refining, and the prospect of larger quantities of natural gas, to be used both as raw material and as fuel, through the development of the newly-found Gela deposits.

Danilo Dolci is not a Sicilian. His appeals for foreign charity may deeply offend local pride and create suspicion for foreign entrepreneurs, who may wish to try their hand in the development of Sicilian economic resources. Even to Sicilians it is clear that their island is rich in manpower, willing and intelligent if as yet unskilled. But foreign enterprise would do well to consider the great facilities they would enjoy through favourable fiscal legislation promoted by the autonomous regional government of the island and the relatively low cost of the investment capital which is made available for this purpose.

Foreign loans have already played an important part in reclaiming the Catania plain (in eastern Sicily), where underground water has been found in sufficient quantities to irrigate a large area comprising poor wheatfields and transform it into high-yield citrus groves. A miracle of the same kind could perhaps also be achieved by modern engineering in the backward Palermo province if power is made available in plenty to drill for water or to distill irrigation water from the sea. Here there is a case for the use of atomic energy. In the conditions it might reasonably compete with electric power locally produced and expensively distributed from conventional plants.

The evils exposed by Danilo Dolci, the charitable man, could undoubtedly be tackled and ameliorated if Dolci, the engineer, could take into his confidence his colleagues wherever they can be reached by a book, articles or even a lecture, and persuade them to throw their weight, in their own way, into his crusade.

ALDO CASSUTO

The Reviewers

Mr. Patrick Moore is best known for his television broadcasts on astronomy. But he has also written many books on kindred subjects, including a detailed and comprehensive study of the Moon. An amateur astronomer himself, he has two telescopes and has frequently been able to fill gaps in the official records of astronomical events. He is a fellow of the Royal Astronomical Society, is director of the Mercury and Venus Section of the British Astronomical Association, and was secretary of the Lunar Section from 1945 to 56. His interests extend to space travel and he is a member of the British Interplanetary Society, editing its magazine *Spaceflight* until recently. He has also written an amusing book analysing the various schools of science fiction, but is implacably averse to bug-eyed monsters.

Mr. Colin J. Albu is employed by a firm of market consultants, and though his degree is in English literature he is gradually assimilating the facts of technical and industrial life. He is not above reviewing children's books for, as he confesses, he is still a child in the context of science and engineering, to which he comes with a fresh and open mind.

Mr. Aldo Cassuto is a journalist and writer on economic affairs. Though resident in Britain, he has retained his Italian nationality and is correspondent to several Italian journals and newspapers, including the Government party's *Il Popolo* of Rome. He has also contributed widely to London newspapers and was responsible for producing a comprehensive "Economic Survey of Sicily," published by *The Statist*. During the war he served with the BBC as Italian broadcaster in the European Service. Recently he has concentrated his attention on atomic energy and began by translating a popular but authoritative book on the subject into Italian, under the sponsorship of the Banca Nazionale del Lavoro, long before Italy began its nuclear power programme with the purchase of a 200 MW gas-cooled reactor from Britain. In 1954 he visited Texas to report on the production and distribution of natural gas. In 1919 Guglielmo Marconi allowed him to send from Chelmsford what in fact was the first Press message ever to be transmitted by wireless telephone inaugurating the Rome receiving station of San Paolo.

NEW BOOKS

La Détermination Purement Optique des Constantes E, ν, G des Matières Isotropes Transparentes: Contribution à l'Étude des Plaques Minces Fléchies d'Epaisseur Brusquement Variable. By MARZIO MARTINOLA. Publications du Laboratoire de Photoélasticité, Ecole Polytechnique Fédérale, Zürich, No. 7. *Verlag Leemann, Arbenzstrasse 20, Zürich 34, Switzerland.* (10 *S Fr*)

The title provides a sufficient summary of this publication.

Petrographic Investigation of Quaternary Danish Gravel Deposits. By BENT SØNDERGAARD. Progress Report E1. *The Danish National Institute of Building Research and the Academy of Technical Sciences Committee on Alkali Reactions in Concrete, Borgergade 20, Copenhagen, Denmark.* (12 *D kr*)

Fifteen other reports have been issued by this body, all equally specialised. Fourteen references and a 2-page English summary to this 74-page report. No doubt invaluable to anybody contemplating importing Danish gravel.

Untersuchungen über Frequenzstabilisation im Mikrowellengebiet. By ALEXANDER BRÄNDLI. *Verlag Leemann, Arbenzstrasse 20, Zürich 34, Switzerland.* (5 *S Fr*)

From an English summary: "A microwave discriminator of the 'equal arm discriminator' type is investigated using a variable resonant cavity and special ridge waveguide modulator and detector." 50 pages and 23 references.

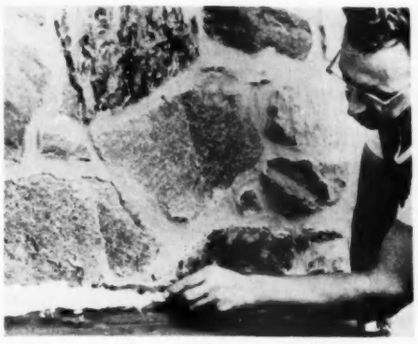
Praktische Spannungsoptik. By LUDWIG FÖPPL and ERNST MÖNCH. Second Edition. *Springer-Verlag.* (30 *DM*)

The first edition was published in 1950. A bibliography of 128 items in a 209 page book *might* be taken as indicating that the book contained nothing very new. On the other hand, the essence of those 128 references will save a lot of reading—if one can read German.

Elastomers Improve Sealing and Glazing

New two-part caulking compounds are predicted to have double the life of white putties. Elastomers on which such compounds are based include polysulphides, urethanes, acrylics, polybutenes and neoprene. The last of these, neoprene, is also featured predominantly in several preformed seals used for curtain wall construction, weatherproofing and general glazing.

By Neil Catton,
Du Pont, USA



Figs. 1 and 2 The application of two-part caulking compounds.

Crack filling and glazing products are very old. Earth putties, the first of these materials, were used centuries ago. Many people are familiar with oil whiting putties, which in time harden and lose their adhesion to window frames. This one-part caulking compound in the past has consisted mainly of a vegetable or hydrocarbon oil with an inert filler, such as asbestos fibre or whiting. Recently, however, a variety of synthetic-based resins filled with asbestos fibres and other inert materials have come into use. Urethanes, acrylics, polybutene and polysulphide elastomers form the base for these mastic caulking materials. After application they increase in hardness and lose elasticity. The older types of oil whiting putties have a life expectancy of 8 to 10 years whereas the newer elastomer-based materials are predicted to have a 15 to 20 year life.

TWO-PART CAULKING COMPOUNDS

While there are many places where one-part putties will serve well, the more exacting requirements of modern construction demand a more elastic, longer lasting material. Some of these requirements are being satisfied by the two-part caulking compounds on the market today, shown in course of application in Figs. 1 and 2. These materials are the polysulphide-base compounds, the neoprene-base compounds and some of newer urethane, acrylic and polybutene-base materials.

Most two-part caulking compounds require the addition and thorough blending of the curatives into the base caulk prior to using. These curatives promote vulcanisation over a period of time and are responsible for the development of useful elastic properties. Such compositions contain 95 per cent or more solids and shrink very little on drying and curing. They may be designed for gun or knife application and are generally available in a variety of colours.

If not properly mixed on the job, however, they are apt to give poor results. Moreover, the surface to which they are applied must be scrupulously clean in order to obtain the adhesion required to produce satisfactory seals. The two component materials generally do not work well in cold weather and have short pot life in hot weather.

PREFORMED SEALS

Resilient gaskets as a class represent a type of seal that is as old as the use of weatherstripping in doors and windows. Within the last few years the use of new products, together with much development work, has greatly increased the variety of resilient sealing systems available. Commonly called resilient gaskets or preformed seals, they depend upon elastic properties under compression rather than adhesion for their sealing action. This is an important difference from caulking materials. It results in substantial savings in on-the-site labour since meticulous cleaning of surfaces is not necessary. Proper function and long service life depend to a great extent on design.

Both the resilient gasket and the seal must be designed to work as a unit. This means that the designer must have a good knowledge of the characteristics and the physical properties of the materials with which he is working. For this reason resilient gaskets are generally designed on a custom basis for a specific application. Preformed seals developed in this manner are not costly. They are made from conventional plastic and elastomeric compounds, processed on standard rubber manufacturing equipment. The seals are extruded by forcing a plastic material through a forming die to produce the desired shape. This process lends itself to the manufacture of long lengths. Extrusion, unlike moulding, is a free-forming process. The ultimate product and shape results both from the shape of the die and the expansion and contraction characteristics of the material itself.

The plastic materials include polyvinyl chloride, polyvinylidene chloride, polyvinyl alcohol, and nylon. All of these materials are thermoplastics and are readily reduced by heat to a soft plastic state; and (while plastic) they are easily forced through the extrusion die. As soon as formed, they are rapidly cooled and solidified to retain the desired final shape. Gasketing of this material may be manufactured with quite complex shapes with good retention of the details of the extrusion die. In service the thermoplastic nature of these materials causes them to become stiff at low temperatures and to flow under continued pressure at normal and slightly elevated temperatures.

FILLERS AND SOFTENERS

These basic characteristics, however, may be somewhat minimised for a while by modification with inert fillers and softeners. Plasticiser loss by volatilisation results in shrinkage which will in many cases cause loss of the seal. Another problem is that care must be taken to select plasticisers which will not migrate into and on to adjacent parts of the structure and cause discoloration or corrosion.

It is popularly thought that these plastic extrusions are more economical than some of the elastomeric materials. This thought stems from the economy of manufacture as a result of the simplicity of the process rather than from a consideration of the cost of the basic material. In fact, as the volume of the cross section is increased, these thermoplastics closely approach the cost of the better qualities of elastomeric preformed gaskets.

Natural and synthetic rubbers, on the other hand, are thermosetting materials and require vulcanisation to convert them from a soft, easily shaped plastic state to a tough elastic material. Vulcanisation is accomplished by a chemical reaction catalysed by heat after preforming. Because of the curing method and the chemical change that has taken place, heat sealing properties have been sacrificed. In addition, some sharpness of die deformation has been lost. As compensation, these materials possess good permanent elasticity and the ability to maintain these characteristics over a long period of time. Cornering can be practically accomplished by either moulding the corners at time of manufacture or through the use of some newer neoprene resin-base adhesives at the time of application.

Many inoperable and relatively static metal-to-metal joints in curtain wall systems are designed to accommodate some sliding movement in overlapping parts. These are applications that cannot be handled by mastic type sealers. Further, these applications require the resilient properties of elastomers for best performance.

METAL OR RUBBER WEATHERSTRIP

Closely allied to the inoperable permanent seal are operable seals or weatherstripping for doors and windows. Here metal strips have been used satisfactorily in various forms for years. Even though expensive stainless steel spring gaskets are coming into use in some of the newer designs for windows, this type of sealing does not provide continuity at corners, and splices. It does not work well in contact with rough surfaces. More research and development surely will be done in adapting these metallic seals to building applications. The working joint seal must not only accommodate changes in component parts due to the expansion —contraction forces, but they must also accommodate changes in position of component parts due to expansion and contraction forces. They should accommodate deflections and movements due to wind loads as well. More operable or working joints probably will be used in the future than have been the case in the past. It is in this area that preformed gasketing from neoprene is destined to play an important role.

The elastic characteristics of the neoprene gaskets make them ideally suited to maintain a seal over a variety of conditions, and to accommodate the ever-increasing tolerances found in today's materials of construction. Modern buildings are being designed by forward-looking architects who are taking full advantage of the inherent economies of curtain wall construction. This was made possible by the development of elastomeric seals. The benefits of using neoprene gasketing for these applications are many. Some are listed below:

(1) Resilient base protects from distortion.
(2) Savings in job site labour.
(3) Economic advantage of being unaffected by poor housekeeping, compared with most

other sealants.

(4) The best qualities of neoprene engineered seals can be used with no more than a 15 to 20 per cent increase in total cost over conventional putty glazing and with much better results. However, as high as 50 per cent savings on total installed cost are being shown over polysulphide-based caulking.

GASKET PLUS MASTIC

Because of these advantages, interest in this type of sealing is growing rapidly. The Pawling Rubber Corporation of Pawling, New York, for example, has developed what is called a "wet seal," one of the most effective types of preformed gasketing. Fig. 3 shows the seal set in place, but before tightening the back-up strip. The mastic sealing compound is contained in channels built into the neoprene extrusion. The completed seal with the strip tightened into position is shown in Fig. 4.

The mastic sealing compound has been forced out against the faces of the glass and frame providing a positive adhesive seal in addition to the compression seal provided by the remainder of the gasket. This is accomplished without any additional labour. The design shape of this product enables easy deformation and sealing of both sides of the panel of glass in one operation. It automatically places the exact amount of mastic at the proper place in the seal. This design will permit looser rabbet tolerances because it will deflect more without excessive bolting pressures.

The "wet seal" was used with success in the Time-Life Building, near completion in New York City. The Pawling "wet seal" may appear complicated but actually is not. This does not mean, however, that the compression principle cannot be used to advantage in simpler designs. For example, a simple U-channel, such as shown in Fig. 5, was developed for use in the Arrivals Building at the Idlewild International Airport in New York. This U-shaped extrusion was fabricated into large rubber band-like gaskets by moulding the corners in the factory. On the job the gaskets were snapped over the edges of the panel or glass, and the assembly placed in the frame. Pressure was exerted through a movable stop, creating a seal against the two elastic legs of the U-channel. This design can offer economy, provided sufficient uniformity of size of channel and other component parts can be developed so that pressure stops can be readily set to a predetermined position.

Other types of sealing strips are those developed by the Inland Manufacturing Division of General Motors and by the General American Transportation Corporation. They are shown in Figs. 6 and 7.

When the architect approaches the problem of sealing a monumental building, he must think in terms of 50 years, and in some cases longer.

Fig. 8 The elastomer neoprene shows high resistance to weathering.

Evidence to date indicates that properly designed and manufactured seals of neoprene will last close to 50 years and maybe longer. The material has demonstrated outstanding resistance to weathering the 27 years it has been commercially available. An example of its durability under all types of weathering conditions is shown in Fig. 8. This figure shows a neoprene and a rubber-covered cable which have been exposed to the weather for 24 years. Unlike the natural rubber, the neoprene is still in excellent condition.

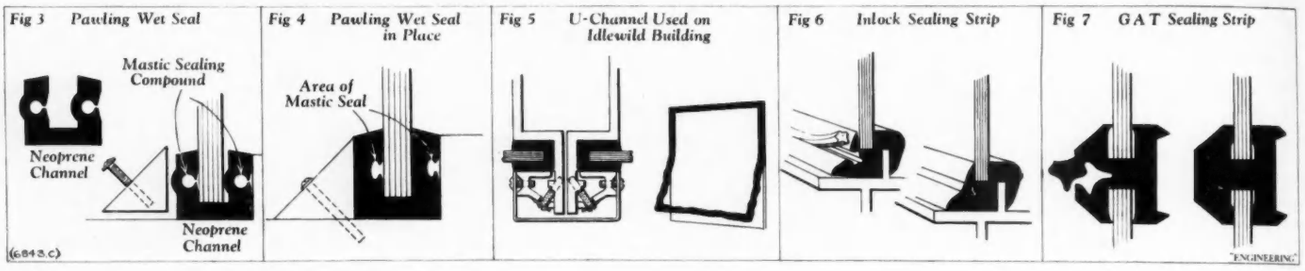
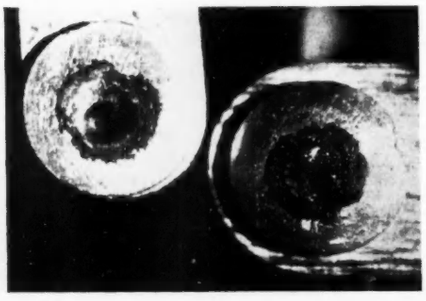


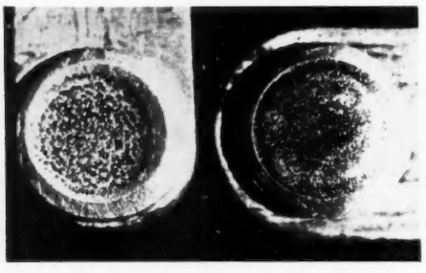
Fig 3 Pawling Wet Seal
Mastic Sealing Compound
Neoprene Channel
Neoprene Channel
(6843.C)
Fig 4 Pawling Wet Seal in Place
Area of Mastic Seal
Fig 5 U-Channel Used on Idlewild Building
Fig 6 Inlock Sealing Strip
Fig 7 G A T Sealing Strip
"ENGINEERING"

WHY LUBRICATE CONTACTS

Whether or not you like the idea of "lubricating" electrical contact faces, it is impossible not to be impressed by specific instances where benefit has resulted. One such lubricant is Electrolube—first announced two and a half years ago—made by a company of the same name in Slough.



Contact faces after 320,000 makes and breaks; above, untreated; below, treated with lubricant.



The following pictures illustrate use of undiluted Electrolube 2 (there is a diluted variety No. 1) on electrical relay contacts. These were the test conditions:

Relays	Lucas type SB 40-1
Contacts	Domed, german silver
Contact gap	0·036 in
Spring tension	15 gm
Make or break frequency	42 per min
Current through contacts	3·4 A
Contacts in series with	car ignition coil, primary 10 mH, secondary 62 H, and spark gap.

Contact sparking occurred at each make and break on the untreated relay and continued throughout the test. After 320,000 operations there was the contact burn and metal transfer shown in the upper illustration. Treated with Electrolube 2 there was initial sparking at contact faces but this was spread over the entire face and died out after 500 operations. After the same total number of operations there was no metal transfer but considerable impact deformation—as shown in the lower illustration—had occurred.

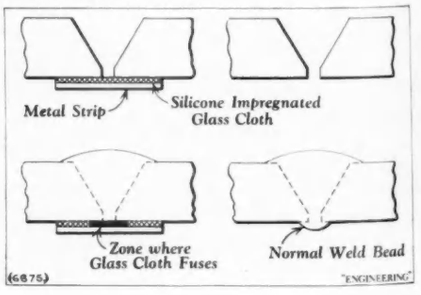
Because of dispersal of fluid, liquid had to be reapplied at increasing frequency which reached once every 10,000 operations after 200,000 cycles. It is interesting to note that the untreated contact resistance increased from 0·006 to 0·008 ohms while the treated decreased from 0·006 to 0·0045 ohms during the 320,000 operations.

Some people have found treatment of commutators with this lubricant beneficial—one Canadian firm speaks for instance of an 800 per cent increase in life of a heavy duty motor—but trouble could be encountered through short circuiting across mica spacers.

SILICONE BACKING STRIPS

A weld backing strip which comprises a silicone impregnated tape and a metal strip has been patented in the UK under the name of Midland Silicones. The resin in the strip is a new one, MS2704, and is used more generally for bonding and for pressure-sensitive tapes. In this welding application a glasscloth tape is impregnated and backed up with a metal strip. During welding, there is probably fusion to a glassy mass under the weld, but there is insufficient heat transferred through the glassy layer to melt the supporting metal. After cooling the whole can be stripped off and the residual ash removed by brushing to yield a smooth weld which requires no grinding.

Midland Silicones, of 68 Knightsbridge, London, SW1, have not yet learned of tests to establish what thickness or size of tape and metal strip is best. In any case, they would only distribute the adhesive. Anyone contemplating experiments with such a system before a tailor-made product is marketed, however, might note that the impregnation of glasscloth with the resin is a relatively straightforward operation, and that in America the process has operated satisfactorily for welding both steel and aluminium.



Jet Thrust Reversal and Reduced Noise

A system of 'eyelids' fitted in the jet pipe is used by Rolls-Royce to obtain thrust reversal, which allows jet aircraft to have short landing runs. In some installations the system can be combined with noise suppression nozzles.

During its landing run, a jet-powered aircraft lacks the braking action afforded by slow turning propellers. This, together with the low drag of its streamlined exterior, results in an excessively long landing run, which can be shortened only by the use of massive brakes or braking parachutes, which on icy runways may be inadequate.

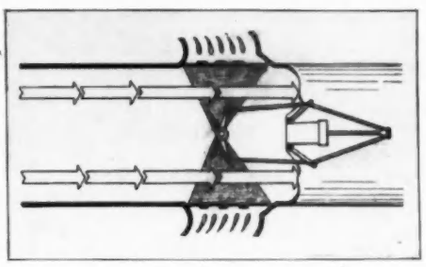


Fig. 1 Thrust reversal " eyelids ".

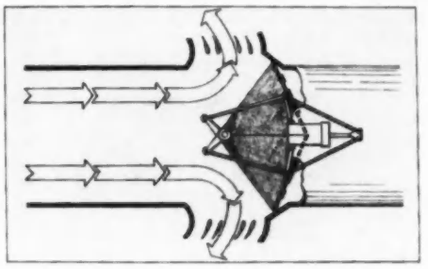


Fig. 3 Gas stream deflected forward.

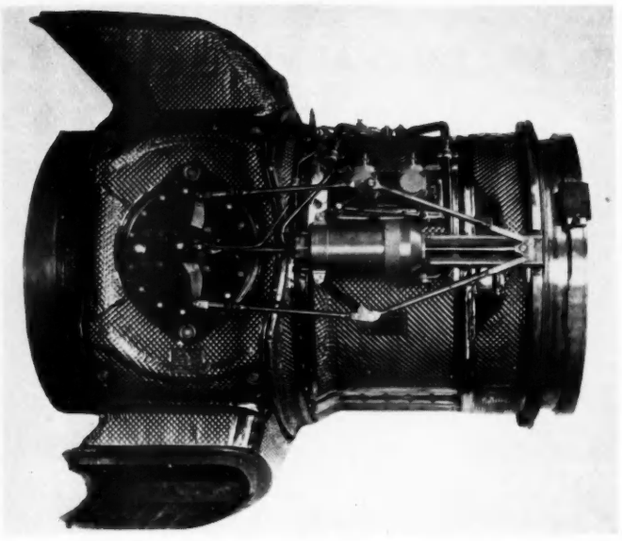


Fig. 2 Linkage on the Rolls-Royce thrust reverser for the Comet 4.

Fig. 4 Silencing nozzles and thrust reversers fitted to a Conway engine.

A simple and effective way of slowing up the aircraft quickly after landing is to reverse the direction of engine thrust by using a reversal unit fitted in the jet pipe. When this unit is installed, normal engine operation is not affected, for the reverse thrust ducts remain closed by the " eye-lids " shown in Fig. 1, until the aircraft has touched down. Movement of a control then operates a pneumatic ram which (through a linkage, Fig. 2) rotates the " eyelids " to uncover the ducts and close the normal exit (Fig. 3). Deflector vanes direct the gas stream forward so that the jet thrust opposes the motion of the aircraft. The braking effect can be controlled by operating the throttle in the normal manner. As engine power is increased, the reverse thrust builds up to about half the value available for forward propulsion.

The unit can be used with either " podded " or wing-mounted engine installations and the reverse thrust ducts positioned accordingly. Nacelle doors in the pod fairing or the wing surfaces cover the ducts when not in use. In some installations the unit can be combined with a noise suppression nozzle, see Fig. 4.

Jet engine noise is caused by the turbulence that results when the jet exhaust mixes with the atmosphere. The turbulence increases with the speed of the exhaust stream, and produces a noise of varying intensity and frequency until mixing is complete. An engine designed to have a slower moving jet stream (a bypass turbojet is one example) is quieter than a straight jet engine of equivalent thrust.

The thrust depends on the speed of the jet as it leaves the propelling nozzle and the noise will be reduced if the mixing rate is accelerated and the speed of the jet relative to the atmosphere reduced as quickly as possible.

Continued on next page

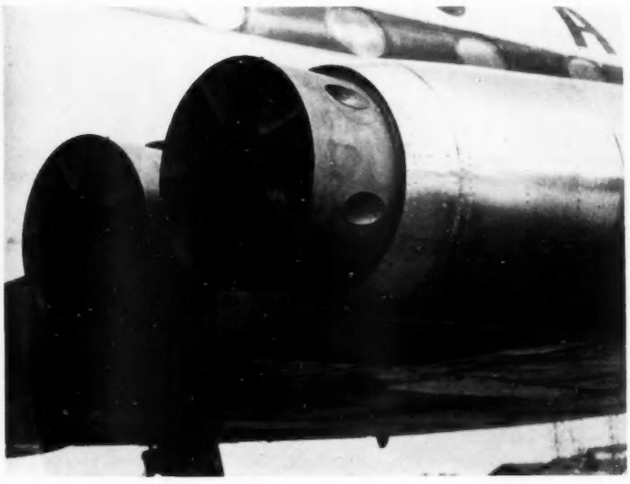


Fig. 5 (left) Silencing nozzles on the Comet 4.

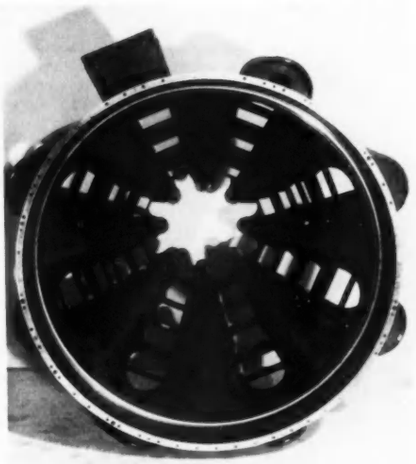


Fig 6 (right) View inside the Conway silencer.

A " solid " jet stream (Fig. 7) will obviously take a long time to mix with the atmosphere and one method of speeding up the process is to break up this " solid " mass by mechanical means. For example, a corrugated jet nozzle that alters the shape of the exhaust stream as it leaves the engine allows air to be entrained with the gases and encourages more rapid mixing.

By admitting a secondary flow of air into the exhaust through the corrugations (Fig. 8), the mixing process is encouraged and the high drag of the nozzle reduced to an acceptable value.

The deeper the corrugations, the greater is the noise reduction but, in practice, the penalties incurred may limit the depth to less than the maximum. For instance, to maintain the required nozzle area, the overall diameter may be so great that excessive drag results. In addition, a nozzle designed to give a large reduction in noise may weigh too much.

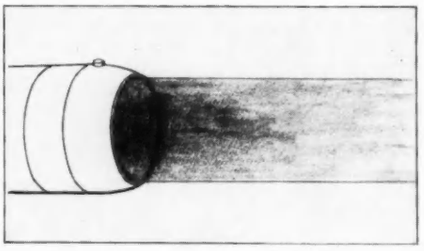


Fig. 7 An " unmixable " solid jet.

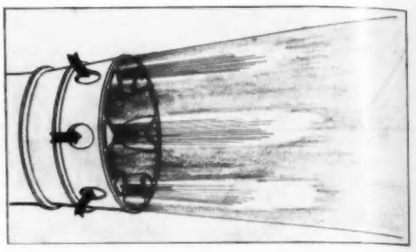
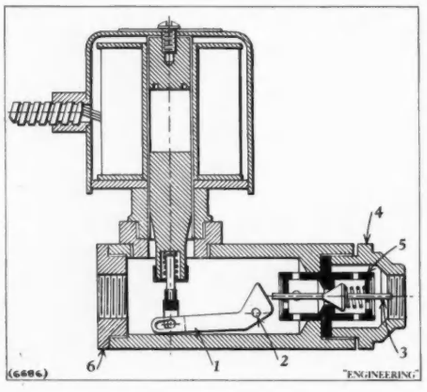


Fig. 8 Secondary air (arrowed) helps mixing.

A compromise offering a reasonable reduction in noise intensity with the smallest loss in engine thrust and increase in weight is therefore the designer's aim.

The Rolls-Royce noise suppression units being developed for the Avon engines in the de Havilland Comet and for the Conway engines in the Boeing 707, see Figs. 5 and 6, reduce the noise level to that of contemporary long range piston-engined airliners.

SOLENOID OPERATED LEVER VALVE



A completely new lever valve, which has undergone extended trials by a number of industrial users of high viscosity oils (all of whom report on it most favourably) has been introduced by Black Automatic Controls Limited, Leafield, Corsham, Wilts. It is of particular interest to manufacturers of package boilers.

A corresponding 3-way version is available for use with pre-heating and recirculating systems. Greater power is available from the diaphragm-operated version of these valves.

When fitted as shown, the valve is of the normal " energised to open " pattern. In other words, when the solenoid is energised, the actuating lever (1), pivoting on the fulcrum pin (2), moves the valve spindle and cone (3) out of the orifice against the pressure, thus opening the valve.

If, on the other hand, reverse action operation is required (that is, energised to close) it is only necessary to unscrew the nose cap (4), remove the valve cage (5), turn it round and re-insert, screwing on the nose cap to retain the cage in position. When fitted in this manner, the inlet pressure keeps the valve open until such time as the solenoid is energised, and the actuating lever (1), pivoting on the fulcrum pin (2), moves the valve spindle and cone back into the orifice, thus closing the valve.

A further advantage is that the customer can fit complete valve mechanism cages (having different sized orifices) to suit any particular requirements he may have. Furthermore, spare nose caps (4) and rear connectors (6) tapped for different pipe threads can be supplied. This means that the customer can modify existing valves that he already has in stock.

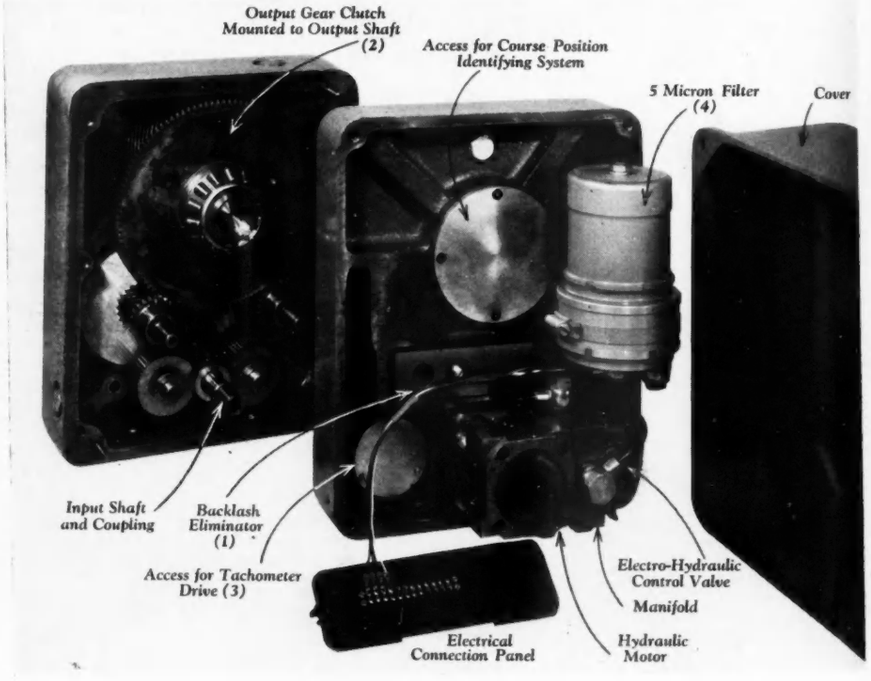
HYDRAULIC GEARBOX FOR MACHINE TOOL CONTROL

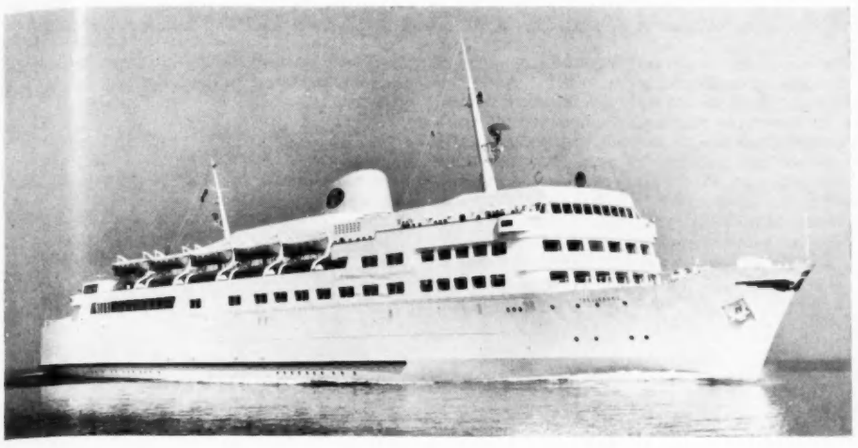
The hydraulic gearbox used in the Ferranti Limited, Edinburgh, system of machine tool control has a precise 50 : 1 overall ratio, with the compound gears arranged with prime numbers. The gears are case hardened and profile ground and designed in accordance with BS 436 for 26,000 hour life when loaded to 4 h.p. continuous rating.

This is a design case chosen for use with the Lucas IP 60 type motor working at a system pressure of 2,500 lb per sq. in in conjunction with a Moog type electro-hydraulic control valve. For most applications it is intended to run at system pressures of about 1,500 lb per sq. in, in which case advantage will be taken of the lower torque output of the motor to reduce the output backlash loaded level to a more appropriate figure.

The gears are journalled on needle bearings and thrust loads are taken by Timken bearings on the output shaft. The gearbox layout is of the double gear train type with half torque backlash loading by means of a spring-loaded member. Both gear trains are identical, and the backlash control (1) is by means of a rocking lever defining the axial position of the helical gears that mesh with the output gear. The output gear (2) itself clutch drives the output shaft and arrangements are provided for the variation of the slip level in order to protect the machine tool transmission. This form of protection is variable up to 1,000 lb-in output torque (representing 1 h.p. output) and subsequently it is recommended that this gear be keyed to the output shaft to cover higher output power ranges. This then assumes that the transmission will withstand the full stalled torque of the drive motor. Access is available (3) on the motor drive side of the gearbox for mounting a tacho generator alongside the motor to run at motor speed using the first reduction gear as an idler. The blanking plate is shown where access is available. In addition ready access is available at the output shaft for driving a position identifying system. This side of the gearbox also houses a 5 micron filter (4) for the hydraulic oil circuit, covered by a cast-aluminium cover.

The recommended coupling between this gearbox and the machine transmission screw is a flexible member with no angular backlash.


Output Gear Clutch Mounted to Output Shaft (2)
Access for Course Position Identifying System
5 Micron Filter (4)
Cover
Input Shaft and Coupling
Backlash Eliminator (1)
Access for Tachometer Drive (3)
Electro-Hydraulic Control Valve Manifold
Electrical Connection Panel
Hydraulic Motor



The largest train-car ferry in Europe, m.f. Trelleborg, used by the Swedish State Railways. Built by Elsinore Shipbuilding and Engineering Co. Ltd., she carries 1,500 passengers, 40 loaded railcars and about 40 cars.

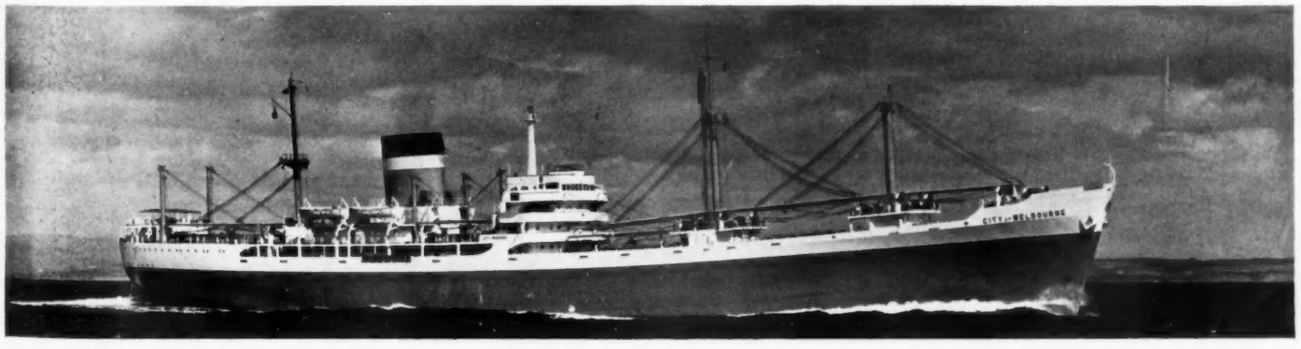
The m.v. Storrington (Burntisland Shipbuilding Co. Ltd.) is equipped for the St. Lawrence Seaway.

Pushboat Olivier van Noort, recently delivered to Netherlands Rhine Navigation Company of Rotterdam, is the first Dutch-built tug of this type.

Vosper's HMS Brave Borderer on trial. The boat is powered by three gas-turbines, each of 3,500 b.h.p. max., the top speed being over 50 knots.

The fire-fighting tug Cardon, built by Lobnitz and Company for Compania Shell de Venezuela, has diesel electric machinery by Metropolitan Vickers.

M.s. Bulimba (British India Steam Navigation Co. Ltd.) is the first cargo liner of her type built in this country to use a.c. current for all purposes.

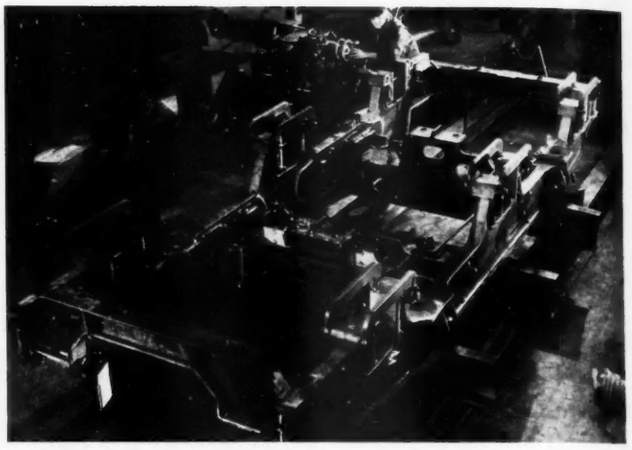


Designed for fast service between this country, Canada and Australia, the motor liner City of Melbourne, built by Alexander Stephen and Son Limited.

DIESEL-ELECTRIC LOCOMOTIVES FOR THE ARGENTINE

Twenty-one 1,000 h.p. mixed traffic units made by the English Electric Company Limited have been added to the Argentine State Railways fleet of diesel locomotives. They are now entering service on the General Belgrano Railway and are similar to five units supplied to the Buenos Aires Provincial Railway in 1956. Power and transmission components for the new locomotives, they are double bogie metre gauge units, were manufactured at the Preston Works, while the mechanical parts are products of the Vulcan Foundry Limited and Robert Stephenson and Hawthorns Limited, both members of the English Electric Group.

(*Left*) *One of the diesel-electric locomotives.*



(*Right*) *Upside-down view of a bogie.*

The English Electric type 8 SRKT engine, with its main and auxiliary generators, forms one flexibly mounted unit. The engine is a four-stroke, pressure-charged in-line unit, with 8 cylinders of 10 in bore and 12 in stroke, rated normally at 1,000 h.p. at 850 r.p.m. To meet the conditions of high temperature and humidity, however, the engine is derated to 940 b.h.p. at 850 r.p.m. at which the b.m.e.p. is 116 lb per sq. in. Two Napier exhaust gas turbochargers are fitted.

A water-circulating pump and two lubricating oil pumps are provided, driven from the "free" end of the engine crankshaft. One of the lubricant pumps circulates oil from the engine sump through oil radiators. The other delivers oil through filters to the main crankshaft bearings, from which oil passes through drillings in the crankshaft to the connecting rod big ends and gudgeon-pin bearings. Forced lubrication is provided also to camshaft bearings, camshaft and pump drives and also to the valve gear. The governor is driven from the camshaft at the flywheel end of the engine.

Protection features for the engine include an overspeed trip device which automatically shuts down the engine should its speed rise above a predetermined maximum. In the event of low lubricating oil pressure, or if the cooling water level falls below a certain point, the engine automatically shuts down. In addition a warning light at each driving position changes from dim to bright, at excessively high water temperature.

Mechanical Parts

The underframe of the locomotive is of fabricated construction, its main longitudinal members (they extend for the full length) being of the truss type, deepened towards the centre to form the sides of the fuel tank. The superstructure is fabricated as a unit, welded to the underframe and is divided into five compartments, separated by bulkheads. Behind the nose compartment is the full-width driving cab, in which there are driving positions for each direction of travel. Next come the engine room, radiator compartment and compressor compartment. Removable roof sections and hinged roof hatches provide easy access for maintenance.

The three-axle bogies are of the swing bolster type, with robust frames of fabricated construction. The bogie frame is carried on four nests of coil springs resting on axlebox underslung equalising beams. The position of the coil springs is so arranged that the static axle loads are equalised. Load from the locomotive superstructure is transferred to the bogie frame through a fabricated bolster to four laminated spring groups. Two of these groups rest on each spring plank, which is suspended from the bogie transoms by inclined swing links. Lateral movement of the bolster is limited by stops. Bogie centre pivots fitted to the underframe engage with the pivot centre on each bolster.

Road wheels and traction motor gear wheels are pressed on to the axles and the axlebox is of the roller bearing type. There are four brake cylinders per bogie, one cylinder for each motored wheel and a handbrake for parking.

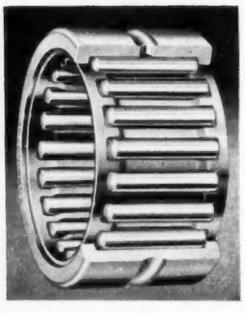
ROLLER BEARING WITH ONE-PIECE CAGE

Channel-shaped outer ring roller bearings, introduced by the Torrington Company of Connecticut, have a new cage design that permits the bearings to be used at higher speeds than with full complement types. Longer and larger rollers in these standard inch-size cage-type roller bearings result in greater capacities than before.

Catalogue 359 is available on request from Torrington Sales, Limited, 10 Splugenstrasse, Zürich 10, Switzerland.

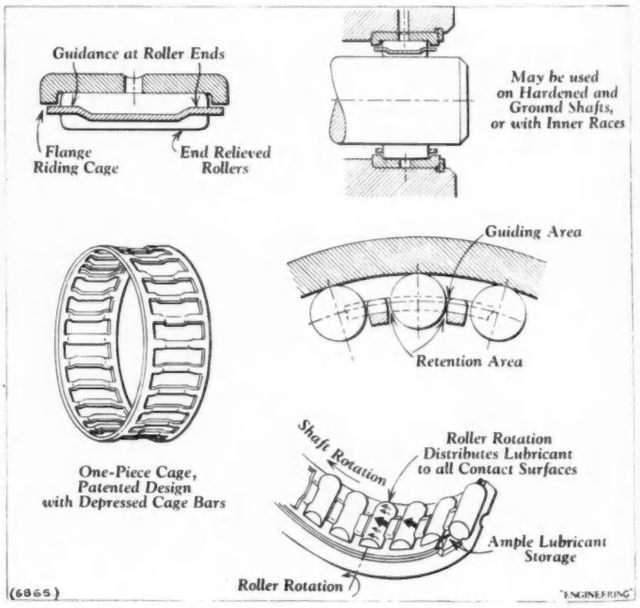
The one-piece cage design separates the functions of roller guiding and roller retaining, by employing a cage bar depressed within the roller pitch circle. Roller guidance takes place at the ends of the rollers, and at the pitch line where guidance is the most effective with the least friction. The rollers are retained by the middle portion of the cage bar, which is always out of contact with the rollers during operation, thus preventing the needless wiping away of lubricant common with ordinary cylindrical cages. The lubricant circulates freely through the bearing.

The rollers have controlled contour profiles, the diameter of the ends being a few hundred-thousandths of an inch less than that in the middle. This end relief design prevents stress concentration at the ends of the rollers and consequently gives a uniform load distribution.



(*Above*) *Cutaway view of the bearing.*

(*Right*) *The component parts.*



Fire Prevention is Better than Cure

Over 10,000 fires occur in industrial premises in the United Kingdom every year. The financial loss they cause is incalculable. Yet almost all of them could have been prevented.

Factory fires always get into the news if they are big enough and there have been some in this category lately. But what of the countless smaller ones? Fire brigade statistics show that the number of fires is increasing, and it is an established fact that most big fires start in a small way. A textile mill fire, which cost the lives of eight workpeople, started when the flame of a plumber's blowlamp ignited a small quantity of textile waste. Besides, a fire does not need to be a big one to have a serious effect on production, or to cause personal injury or loss of life. Statutory regulations govern fire precautions to some extent, but it is difficult, if not impossible, to control the risks wholly by legislation. Fire precautions start with an awareness on the part of managements of the possible risks and the application of known methods of fire prevention.

The mechanics of fire are simple enough. There must be a quantity of inflammable material, sufficient heat to cause the material to reach flash point, a supply of oxygen, and a source of ignition. Bring these four requisites together and a fire is bound to occur; if the inflammable material is present in sufficient quantity and the oxygen is abundant—as it usually is, from the air—the fire can become catastrophic in an incredibly short time.

Fire risks vary, naturally, from factory to factory. Some industries will obviously have a far greater potential risk than others. Handling and processing of large quantities of highly inflammable or explosive materials obviously involves a high degree of risk, but it is of interest to note that the high-risk industries—petroleum refining and some branches of chemical manufacture, for example—have an extremely good safety record. The risk is recognised, proper precautions are taken, and strictly enforced; consequently, a fire is rare, and even if one does occur, it is usually brought under control quickly. It is often where the risk is not apparent that the greatest danger lies. Where, it might be asked, are the sources of fire danger? The answer is: everywhere, in every factory, no matter what it produces.

Fire prevention begins, therefore, with an assessment of the risk. Fundamentally, prevention starts, or should start, with the factory building. Modern design, building materials and plant layout make it possible to ensure that the building is not, in itself, a source of hazard and that if a fire should occur it can be controlled with the minimum of risk to personnel and damage to plant, products and structure. Broadly speaking, the design and materials of a building will not cause a fire; the greatest danger is that by providing one or more of the requisites of fire they will promote its spread, possibly to a disastrous extent. To prevent such an occurrence it is desirable to see that the factory buildings contain nothing combustible—a matter which is not so simple as might first appear, for many things are readily combustible, especially when their temperature is raised by some external source, although superficially they may appear to be inert as far as fire is concerned. Because a substance will not ignite easily it does not mean that it will not burn at all. Building design, too, should avoid fire passages, which, though they themselves may be incombustible, can easily transmit fire from one point to another, both vertically and horizontally. Ventilation ducts, lift shafts, stairways and other communications between different parts of a building have to be provided, but they can be so designed that they do not afford a free and easy passage for fire. Measures can also be incorporated in the building design for the automatic detection and extinction of a fire—great damage has been done because a fire was not detected in time. High-risk industries have made extensive use of these automatic devices, with considerable success.

TIDINESS

Good housekeeping is another fundamental of fire prevention. Every factory uses, in greater or lesser degree, something combustible. Even in the general engineering shop there is quite a lot which will burn. Lubricating oil, allowed to accumulate on the floor by a machine, collects dust and dirt and is a first-class source of fire. Cleaning materials, especially when saturated with oil and grease, and waste paper, so easily left lying about, are such simple sources of risk that they are often overlooked. It is frequently the simple things which are the most dangerous; they are so simple and so commonplace that nobody notices them.

Regular cleaning of machines and process plant, the strict segregation of all dangerous materials, provision of suitable receptacles for inflammable wastes, and regular disposal of such materials are easily arranged, and if carried out systematically, will remove one of the basic causes of fire. In some industries, of course, this elimination of dangerous materials is of more importance than in others. Textile " fly "(fluff or dust), for example, is particularly dangerous, especially when it settles on oily surfaces. Flour dust and pulverised coal are both not only inflammable but explosive; in certain conditions violently so. Good housekeeping is directed first at preventing the accumulation of such dust or fluff, by keeping all joints and seals on machines in proper condition, and secondly at removing any such material, should it be unavoidably deposited, before it reaches dangerous proportions.

DANGEROUS MATERIALS

Many materials in normal use in engineering works are potentially dangerous, and they should be so recognised, even if they are used in quite small quantities. Petrol, white spirit and cellulose paints are perhaps the commonest potentially dangerous liquids, while oxygen, acetylene and propane are the most obvious gaseous sources of danger. If they are only used in small quantities the precautions are simple. They should be stored under suitable conditions (manufacturers will make recommendations for particular products) in a building, entirely separated from any production shop, and the minimum possible quantity should be brought out at any one time for use. Obviously, highly-inflammable materials should not be left lying about in the shop until they are wanted again.

Where inflammable materials are used in large quantities, different precautions have to be adopted, though again, it is often possible to store the bulk supplies in a separate building. Of major importance, where inflammable liquids are used in bulk, is recognition of the risk and the provision of means both for preventing fire and for arresting its spread if it should break out. A classic fire which occurred in the United States took place in a modern building covering about 34 acres and thought to be fire proof. Welding operations near to a tank of rust-inhibiting liquid set fire to the contents, and the fire spread through the whole building causing loss of life and damage estimated at £30 million. The fault lay in the fact that the floor space was entirely open; there were no fire walls, and the fire spread at such a rate that it could not be controlled. Provision of fire walls might well have enabled the fire to be localised and extinguished relatively easily.

Dangerous materials are not always those which appear to offer the greatest hazard. It is well known that coal in heaps can, under suitable conditions, catch fire spontaneously. Many other materials can do likewise. Some vegetable products, natural fibres, and many chemicals will, under certain conditions, oxidise and catch fire spontaneously, and such a reaction often takes place under damp, cool conditions of storage which, quite deceptively, appear harmless. Correct methods of storage, particularly with adequate ventilation, will eliminate such accidents. The only safe thing to assume is that if a material will burn at all, under any conditions, it is capable of setting itself on fire; it should therefore be stored accordingly.

IGNITION

Wherever there is a source of heat there is a potential source of ignition of inflammable materials. Every industry uses heat in one form or another, whether for process work or for space heating during cold weather. There are external, natural sources of heat, too. The sun, concentrated perhaps by glass, can ignite combustible materials, and so can lightning. Even the extreme warmth of a summer day can cause fires in factories, though the dangers of both direct sunlight and summer heat can be avoided by correct storage of inflammable materials. Cigarette ends, matches and other smokers' equipment have caused many fires, but it is obvious that they could not do so if smoking were strictly prohibited in dangerous areas and if inflammable materials were not left about in any other parts of a factory. Cutting and welding torches and blowlamps are responsible for hundreds of fires annually, though here again the remedy is simple if it is appreciated from the start that the intense flames projected from such sources can, indeed almost certainly must, ignite any combustible material with which they come into contact.

Far more dangerous, in many ways, than careless acts on the part of workers are the more unexpected sources of ignition—overloaded electrical apparatus, static electricity, or overheated plant and machinery. Arcing, too, even from a small switch, can cause a fire or explosion if the conditions are right. Correct design, installation, maintenance and use of plant obviate any possibility of its causing fires, and for use with dangerous materials, gaseous or liquid, there is plenty of specially designed apparatus, which is perfectly safe if it is correctly installed, maintained and used.

EXTINCTION

If all the known precautions against fire were carried out correctly and at all times, there would rarely, if ever, be a fire. But it is always better to assume the worst, for even with perfect precautions (if such exist) there would always be the possibility of accidents beyond the control of man. Assuming, then, that everything possible has been done to prevent fire occurring, something further is still advisable. If, in spite of care, a fire does break out, two things are important; to detect it at the earliest possible moment, and to extinguish it. Statistics show that most fires break out (or at least become noticeable) when the premises are unoccupied. Reliable fire detection systems are now available, and automatic warning can be given on the basis of either excessive heat or smoke. Such a warning can be coupled with automatic spray equipment, which operates to extinguish the fire before it gets a dangerous hold. If a fire occurs during working hours, it will be seen in its early stages, but might still spread unless everyone concerned knows exactly what to do, and does it immediately.

Finally, there is the question of how to judge the adequacy of the precautions. Local fire brigades will always advise on fire precaution; the fireman is much more interested in preventing a fire than in putting it out. Information and advice are also available from the Fire Protection Association, 31 Gresham Street, London, EC2.

Ford Expansion: Another Phase Completed

The opening of a new body paint, trim and assembly building at Dagenham is the last and largest phase of the Ford £75 million modernisation plan started in 1954.

Expansion by the Ford Motor Company Limited, Dagenham, has been continuous since the end of the Second World War, and has enabled their output to be raised from a daily figure of 372 units in 1946 to 2,000 at the present time. This increase has been achieved by the addition of production facilities which have raised the fixed assets from £14 million to £42 million, the labour force from 15,700 to 40,000, and the floor area from 2·2 million to 9·2 million sq. ft in the same period. The greatest single expansion has been that planned in 1954, and now completed; the cost, some £75 million, having been met entirely from the company's earnings. The major features of the 1954 plan were a new foundry, machine shop, press shop, and a body paint, trim and assembly building. This last-mentioned building completes the present phase of development, but further long-term plans are already in hand, and a large sum of money has been allocated for the purpose. The consulting engineers for the work were Posford, Pavry and Partners, London, SW1.

PRODUCT MOVEMENT

Built on a 48 acre site adjoining the body manufacturing plant, and formerly occupied by the Ford sports ground (new recreational facilities have been provided elsewhere) the body paint, trim and assembly building is of two storeys and is 1,215 ft long and 630 ft wide. It is connected to the body building shop by an enclosed conveyor bridge crossing a main road, and is divided into two principal sections; painting on the upper floor and trimming and assembly on the lower.

Car bodies, made in the nearby body plant, are loaded on to a conveyor, which extends across the bridge into the new shop, carries them right through the painting process and delivers them to the trim and assembly section, where a further conveyor system is used to move the bodies through the process work up to the point where completed cars are ready for despatch. Over nine miles of conveyor, designed and built by Geo. W. King Limited, are used in the new building; the whole conveyor system being automatic, with push-button control. Well over 1,000 bodies, in various stages of paint and trim, are on the conveyor system at any one time.

Flexibility is the keynote of the conveyor system, in spite of its automatic operation. It allows a local controller to divert bodies from one conveyor line to another, to suit the production schedule. It is also designed to allow free movement, in appropriate parts of the plant, of the fork-lift trucks which bring in trim components such as seats, windows and handles. All these items are transported on pallets, which are loaded at other Ford divisions, or at the works of outside suppliers.

PAINTING

On entering the paint shop, which has a floor area of 437,000 sq. ft, the bodies are first cleaned, and then passed in two parallel lines to a six-stage phosphating machine, for which, together with the paint-spray booths, dip tanks, washers, and small parts painting equipment, John Lysaght's Bristol Works Limited, were responsible. Much of the plant installed in this section of the shop is of special design. Phosphate solution, for example, is clarified automatically, the priming and enamel spray booths are equipped with automatic de-sludging systems, and the gas ovens are fitted with heaters of a type hitherto only made in the United States. To ensure that the enamel finish is of the highest possible quality, the air supply to the spray booths is controlled for both temperature and humidity, and filtered by both viscous and electrostatic units.

After leaving the phosphating machine, the bodies pass to a blow-off deck and a drying oven and cooler, and then travel on raised open decks for the upper dust and water-sealing and glazing operations to be carried out. They are then picked up automatically and carried round the end of the shop to the slipper dip tank, which paints the underside of the body and inside the lower box sections. They then pass through a 50 yd drain tunnel to reach the primer spray booth and primer baking oven. At this point two ski-type skids are fitted to the underside of the bodies, and they are again carried by overhead conveyor round the end of the shop and lowered to floor conveyors, where they go through the lower sealing process, the wet-sand deck, water rinse, wet-sand dry-off oven and a cooler; thence they pass to an open deck where they are inspected. Any blemishes which the inspection may reveal are repaired before the bodies pass on to enamel painting.

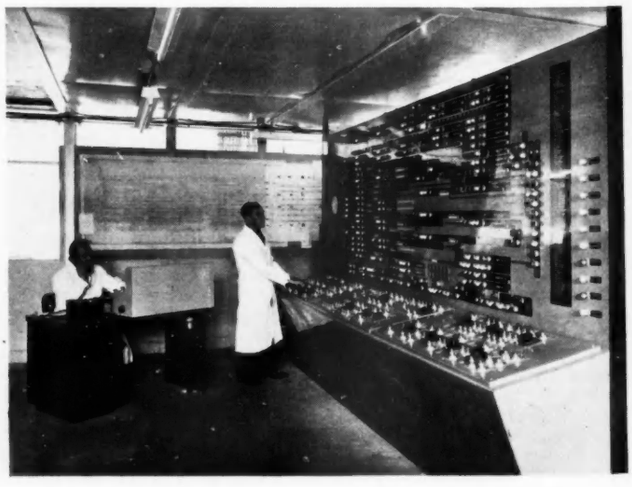
To reach this point, the bodies are turned through 180° on a turntable, and pass down the next line in road position through the ground coat spray booth, oven, wet-sand deck, wet-sand dry-off oven and cooler. They are then passed into the final enamel-spray booth and final bake oven, to emerge for inspection with the six coats of paint they have received on their journey. Bodies for two-tone finish are selected automatically after enamelling and diverted to a two-tone spray line. Both single-colour and two-tone bodies are then ready for delivery to the trim and assembly lines on the floor below.

The new Ford body paint, trim and assembly building will turn out 2,000 cars a day.

Many problems had to be solved in equipping the paint shop, not the least of which was the provision of suitable water supplies for the washing and sanding sections. Normal water contains a relatively high percentage of soluble salts, and if allowed to dry freely, will deposit them on the drying surface. These salts are capable of absorbing moisture, even through a paint film, and, on doing so, will increase in volume and so cause paint blistering. An ion-exchange unit, supplied by the Permutit Company Limited, is therefore installed to deliver about 6,000 gallons of chemically-pure water per hour to the final rinse on the wet-sand deck. Much greater quantities of water (about 25,000 gallons per hour) are needed for the sanding decks, and a Permutit recirculation plant deals with this water. Contamination by bacteria is prevented by a chlorine injection, and the suspended solids are removed by flocculation. The water is then passed through a filter bed and returned to the wet sanding decks.

Air supply presented another problem. Thir-

Bodies are automatically sequenced into model ranges after painting, and held in storage conveyors ready for trimming.



One of the two main conveyor control rooms, which enable the flow of bodies through the whole plant to be tracked and controlled.

Production

teen plenum plants, supplied by Andrew Air Conditioning Limited, provide six changes of air per hour in the areas where operators work. Compressed air for the paint spray booths must be free from contamination, and the three air compressors, supplied by Alley and Maclellan (Polmadie) Limited, which each have a capacity of 1,000 cu. ft of free air per minute, have non-lubricated type cylinders, with carbon piston rings and packings.

Paint is supplied from two central mixing rooms, the complete paint distribution system having been engineered by the Aerograph-DeVilbiss Company Limited. Seven units, each consisting of two 100 gallon paint tanks, air-operated circulating pumps and reciprocating paint agitators, are used in the undercoat mixing room, and in the enamel mixing room there are 15 similar units. Outside, four 1,500 gallon underground storage tanks are provided for thinners. These paint mixing rooms, supply, through 11 miles of piping, 32 primer spraying stations, and 54 enamel stations, the total number of paint take-off points being 842.

TRIMMING AND ASSEMBLY

Three body "drops" connect the paint shop with the trim and assembly shop below. Here, the bodies meet the many components and assemblies which combine to make a complete motor car, and the flexibility of the conveyor system must allow for the possibility of the bodies being incorporated into literally thousands of different combinations of colour, trim, glass, and mechanical equipment.

Bodies lowered to the trim shop are conveyed first through a series of parallel lines, where they are fitted with such items as floor felts, head linings, door trim pads, door handles, door glass, radiator grills, windscreens, rear windows, brake and clutch pedals and electrical assemblies. At the end of each line the bodies are subjected to close inspection, and rectified if required before they pass to the next stage. All trim operations are carried out on a two-strand chain conveyor, and the bodies are transferred from one line to the next by cross-transfer conveyors with power operated lift tables. Although the system is automatic, it is flexible here as elsewhere, and local controllers can divert bodies from one conveyor to another as required. Where aisles are crossed, the conveyors are ramped down to floor level to enable fork-lift trucks to deliver trim stock to the various points required. All internal traffic, by fork-lift truck and electric tug, is controlled by a supervisor, patrolling the shop on a tug, equipped with two-way radio. He is in continuous touch with the control office, which relays information about stock shortages and other problems. When they are fully trimmed, bodies proceed through a water test, or to repair lines if required, and then pass into storage ready for delivery to final assembly.

On the ground floor, finish-painted bodies receive upholstery and other fittings.

While the bodies are receiving their trim, the mechanical equipment of the cars is arriving from other Ford manufacturing divisions, and such items as the engines, steering gear, front suspensions, and rear axles are assembled and moved to their positions on the final assembly line on floor conveyors. At the same time, wheels and tyres are brought in on overhead conveyors from their assembly and inflation point, and another overhead conveyor carries the seat cushions into position.

Bodies are lifted off the trim line by overhead conveyor and lowered on to the engines and transmissions on the final assembly line, which runs at right-angles to the trim lines. A teleprinter system controls this complicated traffic, and ensures that each component or assembly reaches the right point at the right time.

As soon as the mechanical parts have been attached to the bodies, and the other details have been completed on the final assembly line, petrol, oil and water are fed to the now completed cars, flexible pipes leading to an exhaust system are attached to the exhaust pipes, and the engines are started. Cars are then driven to the roll test where a simulated road test is given to check the performance of the brakes gears and acceleration. Detailed inspection of the cars follows this test. They are then driven a short distance to a final preparation area where moved on floor-type conveyors, they receive any minor adjustments or rectifications which inspection may have shown to be necessary, and are finally cleaned and made ready for despatch. Any special preparation required for transport overseas is attended to at this point. The cars are then driven away to the despatch area.

FACILITIES

A separate building houses the administration offices, canteens, kitchens, and the medical centre, which are necessary adjuncts to such a large production unit. Here, facilities are provided for supplying meals to 800 workers at a time, in two canteens each seating 400. As the meal break for hourly-paid workers is only half an hour, the canteens are laid out on cafeteria lines, specially designed to enable meals to be served at great speed. There is also a staff dining room seating 250, and buffet bars serving snacks and beverages. A tea station prepares tea for distribution throughout the new building by means of trolleys at the recognised times during the day. The medical centre in the facilities building combines with those already established in the chassis and body groups to provide a comprehensive medical service, including fully-equipped X-ray rooms and a physiotherapy department.

As the site is at sea level, there was some risk of flooding, and the first task of the main building contractors, G. Percy Trentham Limited, was the laying of 6½ miles of drains and the construction of pump houses to connect them to the outfall points. Spreading and compacting of 200,000 tons of foundry waste raised the surface of the building area to 4 ft above sea level, and some 7,500 piles, supplied by Dow-Mac (Products) Limited, were driven to support the floor slab, which is of reinforced concrete, 11 in thick. Construction of the building was started at the centre, to allow the steelwork contractors, Redpath Brown and Company Limited, to follow up at this point, which was to house that portion of the equipment which would take the longest to install. Ford's own engineers followed closely, using completed parts of the building for storage or installation of plant, and the other contractors started work on the provision of the many services required to complete the building.

A mile-long 11 kV cable was laid from the Ford power station by Crompton Parkinson Limited, who also installed the main switchgear and substation equipment.

Marketing

Industry's Front Door

The use of mobile demonstration units, usually adapted caravans, continues to grow. As some of this growth consists of the extension of mobile exhibition facilities by firms who were first in the field this suggests that the effectiveness of the method has been established. Moreover, its growth under increasingly competitive conditions and its use abroad are in general confirmation that it is indeed a good way into industry's front door.

A very fine demonstration unit is currently touring Britain on behalf of the industrial instrument division of Smiths and Sons (England) Limited. During the first half of October the unit made three calls a day in Scotland (in the forecourts of factories rather than in public locations) and during the second half it will travel in the Midlands. In November the Eastern and North Eastern areas will be covered and next year it will carry out a 20-day tour of Belgium, Holland and Denmark.

Henley's in India

The potential of the Indian market for capital goods has now been held back for so long by Government import controls that many British engineering firms who formerly did big business there have almost forgotten it. It is a similar situation to that which prevailed in Latin America for most of the post war period and only now shows signs of changing. There is a feeling that the Indian situation too may change over the next year or so. The 1960's must see vast increases in the world's investment in under-developed countries, roughly corresponding to the anticipated decrease in armament expenditure. Neutralist India may well be in funds almost before we realise it and once again look outside for supplies of modern plant and machinery.

This may explain the new marketing arrangements W. T. Henley's Telegraph Works Company Limited have made there. They have appointed Voltas Limited, who are one of India's leading distributors of electrical and industrial products, to handle Henley's products throughout the country. Henley's branch offices in Calcutta, Bombay and New Delhi will be closed and the company will rely wholly on Voltas' marketing facilities. Other British firms have taken similar action in recent months. Increasingly it becomes important to operate in India through Indian firms or with the participation of Indian capital.

Success of the Hydrapilot

Few manufacturers of marine equipment have escaped the effect of the marked recession in shipping during the past year, and for any of them to have increased their exports is quite an achievement. Frydenbö Hydrapilot, of Bergen Norway, who export some 75 per cent of their marine hydraulic steering gear products, have announced a substantial increase in their sales this year, which is expected to add "several million kroner to Norway's export revenue in 1960."

Frydenbö Slip & Mek. Verksted, the parent company, stated that steering gear units are exported to 28 different countries. Several orders for special types of new vessels have been booked during the summer. Frydenbö exhibited at the Hanover Fair earlier this year and more recently at the Barcelona Trade Fair where they obtained orders for ten units. Although the new design of the hydrapilot is doubtless responsible for some of the company's progress since it was launched in 1951, energetic marketing is probably the key to their success.

Marketing

Cars and the Common Market

A major step forward in the mass marketing of cars on the Continent was taken recently by Simca of France and Fiat of Italy. The objective is to gain strength in order to meet British, German, and other competition which is expected to become increasingly fierce. How far this step has been influenced by American outlook on European marketing—Chrysler bought the Ford interest in Simca last year—is not clear but the result must be the trend of continent wide marketing on which the Americans have based their own expansion.

The agreement has limited first objectives ; Simca will be responsible for sales of the Fiat range in France, with the emphasis on the small Fiat 500 and 600, while Fiat will perform a similar service for Simca in Italy, with the emphasis on the Simca "Ariane" (which combines the big " Vedette " six-seater body with the "Aronde " engine). Simca sales in Italy have been negligible to date, and the main sales effort will be concentrated on the Ariane, which is not a direct competitor with popular small Fiat models. It may also be Fiat's answer to Renault who made an agreement earlier this year with Alfa Romeo and are now competing with Fiat small cars on their own territory, offering Renault Dauphines assembled by Alfa Romeo. In France, the Renault sales organisation is distributing Alfa Romeos, whose sales in France rose sharply this year.

Farm Machinery Showdown

An unfashionable trend is emerging from the latest returns of agricultural machinery sales. The Agricultural Engineers' Association take the view that the failure of the industry to maintain its expansion in recent months will be accentuated and the industry " will probably revert to the role of relative laggard during the last quarter of the year."

By the end of August the gain in total production over last year's levels was rather less than 10 per cent, suggesting a declining pace even after seasonable factors are allowed for. Exports have been falling and over the first seven months were 10 per cent lower than in the same period of last year. Competition from German manufacturers has been sharpening, particularly in Western Europe.

Soviets Buy Swedish

The ordering of complete factories by Soviet Russia continues. The latest is a large cellulose pulp mill to be supplied by the Swedish firm Karlstads Mekaniska Werkstad. The mill will have an annual capacity of 200,000 tons of prehydrolised sulphate viscose pulp. The order includes the engineering of the plant, which will use a special process based on the experience gained by the Swedish Uddeholm Company. As is usual in such cases KMW will subcontract a substantial part of the order to other firms in Sweden but be responsible for the design, erection and testing of the mill.

At Home

SAFE HOME

During the June quarter of this year more people were killed in their homes than on the roads—1,525 as against 1,419.

True, as a correspondent to *The Times* said, people spend more time in their houses than they do on the roads and one can argue that the rate of deaths per hour is less, but this in no way alters the total toll—a toll particularly affecting the very young and the very old. Of babies under one year, 65 were killed at home, (53 of them by choking or suffocation) and only three on the roads. At the other end, 1,126 people over 65 found accidental death at home (883 due to falls) and only 301 on the roads (207 of them pedestrians).

Figures taken from their context can be twisted to mean almost anything and it is not sense to try to deduce more than is implied. A moments thought will show that it is not usual for babies under a year to be let loose on roads and equally that older folk stay more at home as they become less active, but the fact is not altered that far more people are killed at home than need be.

It must be remembered, too, that the Registrar General's figures include deaths only. No figures are available for the immense number of accidents that do not cause death, but which may well result in permanent injury. Such accidents in the factory or on the roads have to be reported, but not when they happen in the home. Comparisons are therefore not possible, but the accidents must not be forgotten or ignored. How many times among elderly folk does a fall result in a broken hip that will not mend, a tedious time in bed and then death by pneumonia? In the June quarter of 1959 pneumonia was given as causing 534 deaths as against 80 for tuberculosis of all forms and 1 for polio, but how many cases can trace their origin to an accident?

The Royal Society for the Prevention of Accidents are now in the middle of a campaign for which they have chosen the slogan " Check that Fall." Counting all age groups, falls were responsible for the deaths of 981 persons during the June quarter—63 per cent of all fatal home accidents.

Causes of such falls are varied. Overreaching, standing on rickety chairs, tripping over torn floor coverings, slipping on polished floors, and leaning on faulty banisters are among them. From an engineering point of view, bad lighting—particularly on stairways (how many people economise by using a low wattage bulb in the hall and on the stairs?)—and trailing leads must be counted. Bad lighting can be cured by design and choice of position of the lamp, or in many cases even more easily by using a lamp of higher power.

The trailing flex is a real menace. Quite apart from the danger of falling over it, there must always be the risk of a damaged length causing a short circuit and so a fire. A bad example often encountered is the electric iron fed from an overhead light. The only proper cure is again a question of design and planning. It is a point made by several authorities that there should be sufficient sockets arranged around each room to avoid just this trouble. The ring system allows a reasonably inexpensive way of providing for this requirement. The basic trouble occurs, and is likely to persist, in older houses to which electrical wiring was added as an afterthought. The problem will be to eliminate and modernise these older installations.

In the past a great number of accidents have been caused by faulty appliances, electrical, mechanical or gas. Unfortunately these continue in spite of the efforts of such bodies as the Electrical Development Association and the Gas Council. Both bodies issue lists of approved appliances which they have tested and found to conform to the requirements laid down in the appropriate British Standard. For radiant fires the tests include such points as scorching of material laid on the protective guard, whether the element can be reached by a " standard " finger, whether the electrical connections are safe. There are however a large number of appliances still on the market which have never been sent to these establishments and some unfortunately are only marginally safe. Even approved items are no longer safe if damaged or misused.

Permanent electrical installations—if faulty—can cause accidents and are a frequent source of fires. Some guarantee is provided by the National Inspection Council for Electrical Installation Contracting who check the work of contractors and list those who reach an approved standard. During 1958 the Council carried out over 7,500 individual inspections of installations. The body was formed in 1956 to give the ordinary consumer some protection against the odd-job wireman who did not know his job.

Burns and scalds came third highest on the list with 141 deaths. (Second place—with 159 cases—was taken by deaths caused by coal gas poisoning.) It is so natural for a child to reach up and pull on a handle—and a badly balanced saucepan or kettle can tip so easily. A badly designed oil heater can cause a fire if tipped over (*Which?* carried out a survey on heaters in issue No. 5) and gas fires and open coal fires are still dangerous if the regulations regarding proper guards are not followed. In older houses—and in some not so old as well—there still exist gas taps that can be knocked " on " by a child although there are types available that have a locking catch for safety. Similarly not all electric sockets are the type with shutters over the holes, though these too are on sale.

The Committee on Consumer Protection that has been set up by the Board of Trade has decided to include the question of safety standards in its terms of reference, and to give it an early place in the programme. They list: electrical appliances and fittings; oil burning heaters; toys; nursery equipment; highly flammable clothing materials; poisonous or corrosive substances in domestic use: unstable pots, pans and crockery; and plastics bags and bibs, as having been mentioned. They ask anyone wishing: " to inform us as to the frequency and severity of accidents attributed to such products; to make observations for or against the principle of further control in respect of any product; to propose or oppose any particular method of control; to suggest other products for consideration; or to record an interest in the subject " to write before 14 December to the Secretary, Mr. S. W. T. Mitchelmore at the Board of Trade, Horse Guards Avenue, London, SW1.

ENGINEERING

Published every Friday by ENGINEERING LTD. at 36 Bedford Street, London, WC2.
Telephone: Temple Bar 3663.
Telegrams: Engineering Lesquare London.

CHAIRMAN: J. A. Dixon, M.A., A.M.I.Mech.E.
EDITOR: F. B. Roberts, M.B.E., M.I.Mech.E.
DEPUTY EDITORS: D. Fisher, Ph.D., B.Sc., A.M.I.C.E., A.M.I.Mech.E.
E. P. Ward, M.A., A.M.I.Mech.E.
DEPARTMENT EDITORS:
Design: W. L. Morse, B.Sc. (Eng.), A.M.I.Mech.E., A.F.R.Ae.S., A.F.I.A.S.
Metals and Materials: D. C. E. Gribble, B.Sc.
New Plant and Equipment: A. A. H. Scott, B.Sc., A.M.I.Mech.E.
Parliament and Institutions: J. E. Dodsworth.
Research and Development: R. A. Coffee, D.I.C., A.M.Brit.I.R.E.
MIDLANDS CORRESPONDENT: W. K. V. Gale.
EDITORIAL DESIGNER: J. T. Godfrey.
SUBSCRIPTION MANAGER: G. A. Roberts.
ADVERTISEMENT MANAGER: G. H. Dixon.

Annual subscription rates: Inland and abroad, £5 10*s* (Canada, £5 5*s*). Three months 27*s* 6*d* all countries. Single copies, 2*s* 7*d*, post free.

ENGINEERING INFORMATION SERVICE:
Assistance is available from Engineering Information Service in obtaining information, and in locating sources of information, both technical and commercial. EIS deals, for example, with names of makers and suppliers of plant and equipment, technical data on design, markets for engineering products and the compilation of references to information on specific topics. Inquiries should be addressed to Engineering Information Service, 36 Bedford Street, London, WC2.